ROTIFERA FROM AUSTRALIAN INLAND WATERS. III. EUCHLANIDAE, MYTILINIDAE AND TRICHOTRIIDAE (ROTIFERA:MONOGONONTA)

by W. KOSTE* & R. J. SHIEL†

Summary

KOSTE, W. & SHIEL, R. J. (1989) Rotifera from Australian Inland Waters. III. Euchlanidae, Mytilinidae and Trichotriidae (Rotifera:Monogononta). *Trans. R. Soc. Aust.* **113**, 85–114, 31 May, 1989.

Diagnostic keys are given to the Australian representatives of the Rotifera:Monogononta in the families Euchlanidae *(Manfredium, Diplois, Dipleuchlanis, Tripleuchlanis, Euchlanis)*, Mytilinidae *(Mytilina, Lophocharis)* and Trichotriidae *(Wolga, Macrochaetus, Trichotria)*. All species known from Australian inland waters are described and figured, as are some widely distributed taxa not yet recorded from the continent. Distribution data and ecological information also are given.

KEY WORDS: Rotifera, Euchlanidae, Mytilinidae, Trichotriidae, Australia, taxonomic revision.

Introduction

The families of Rotifera:Monogononta considered in this part of our review of the Australian species (see Koste & Shiel 1986b, 1987b) commonly are encountered in the shallow littoral zones of billabongs or vegetated lake margins (cf. Koste 1981, Tait *et al.* 1984, Koste & Shiel 1986a, 1987a, Koste *et al.* 1988). Some species, e.g. *Euchlanis dilatata* and related forms, are known to become planktonic in eutrophic waters during cyanobacterial blooms (Ruttner-Kolisko 1974). This species occurs seasonally in the lower R. Murray, S. Aust. (Shiel *et al.* 1982). Otherwise, species of the Euchlanidae *(Manfredium, Diplois, Dipleuchlanis, Tripleuchlanis, Euchlanis)*, Mytilinidae *(Mytilina, Lophocharis)* and Trichotriidae *(Wolga, Macrochaetus, Trichotria)* generally are benthic or epiphytic in habit, and occur in open water of lakes, reservoirs or rivers only as incursion species during seasonal flushing flows.

Most of the 35 taxa recorded in the three families were collected as such incidental incursions into the limnetic region of billabongs. It is likely that more taxa remain to be described, particularly endemic species, because our initial sampling program was directed at the planktonic community and the sampling bias has "undersampled" the preferred habitat of these littoral rotifers. Only four endemic species are known in the three families, one mytilinid (*Lophocharis curvata*) and three trichotriids (*Trichotria pseudocurta* and *T. buchneri* from Tasmania, and *Macrochaetus danneeli*, from the N.T.). In contrast, about 25% of the taxa in the Epiphanidae and Brachionidae (Koste & Shiel 1987b), true limnetic species (and therefore more intensively sampled), apparently are endemic.

All known Australian representatives of the three families are described and figured, and diagnostic keys are provided to enable identification to species. Widely-distributed taxa not yet recorded from Australia, but which are likely to be found here, are included in some genera. The format follows that of earlier papers; dichotomous keys are followed by individual species' descriptions and known Australian records. Relative abundance from >2000 collections is indicated by: "rare" (fewer than ten records, "uncommon" (10–30 localities) and "common" (more than 30 widely dispersed localities). Brief ecological data are included where available, generally in the sequence: temperature (°C), pH, dissolved oxygen (DO, mg l^{-1}), conductivity (K_{18}, μS cm^{-1}) and turbidity (nephelometric turbidity units (NTU)).

To minimise the citation of previous references to the rotifer families reviewed here, early Australian references which are included in Shiel & Koste (1979) are not repeated, nor are the majority of European references, which are included, for example, in the reviews of Hudson & Gosse (1886, 1889), Weber (1898), Voigt (1957), Bartos (1959), Rudescu (1960), Kutikova (1970) and Koste (1978). A more detailed treatment of the Rotifera outside Australia is given by these authors.

Family Euchlanidae Bartos

The following genera were integrated by Remane (1929–1933) in the subfamily Brachionidae. A special family was erected by Bartos (1959), later accepted by Kutikova (1970) and Koste (1978). With the exception of *Manfredium* the genera are characterized by a lorica with plates which are connected with sulci, a segmented foot, more or less elongated toes, a corona of the same type (*Euchlanis*-type, Fig.3d) and malleate trophi (Fig.2:2b,3).

* Röntgenstr. 1, 2903 Bad, Zwischenahn, Fed. Republic of Germany

†Murray-Darling Freshwater Research Centre, P.O. Box 921, Albury, N.S.W. 2640

Key to genera of the Family Euchlanidae

1. Lorica thin, without lateral sulci, long toes ..... *Manfredium* Gallagher
   Lorica rigid, with dorsal and sometimes ventral plates 2
2(1). Lorica composed of three plates, dorsal divided, separated by sulci ..... *Diplois* Gosse
   Dorsal plate not divided 3
3(2). Dorsal plate arched, concave, narrower than arched ventral plate ..... *Dipleuchlanis* Beauchamp
   Dorsal plate arched, convex or triangular 4
4(3). Dorsal and ventral plates nearly of same size, connected by a lateral double longitudinal membrane within a stiff projection ..... *Tripleuchlanis* Myers
   With and without lateral longitudinal sulci ..... *Euchlanis* Ehrenberg

Genus *Manfredium* Gallagher

Eudactylota Manfredi, 1927, p. 58 (non Walsingham, 1911).

Beauchampiella Remane, 1929, p. 107.

Eudactylota Manfredi, 1927 is a junior homonym of *Eudactylota* Walsingham, 1911 (Lepidoptera). *Beauchampiella* Remane, 1929 is a *nomen nudem* under articles 12 and 16 of the International Code of Zoological Nomenclature (name published without description, definition). *Manfredium* was proposed by Gallagher (1957) to replace *Eudactylota* Manfredi. There is a single species, *Manfredium eudactylotum*.

Manfredium eudactylotum (Gosse)
FIG. 1

Scaridium eudactylotum Gosse *In* Hudson & Gosse, 1886, p. 74, Fig. 21:4.

Eudactylota eudactylota (Gosse) Manfredi, 1927, p. 58.

Beauchampiella eudactylota (Gosse) Remane, 1929, p. 107.

Manfredium eudactylotum (Gosse) after Gallagher, 1957, p. 183.

Diagnosis: Body pear-shaped with soft, transparent cuticle; head small; foot with two longer segments; toes long, rod-shaped; striated muscles visible in caudal part of body and foot; mastax trilobed, trophi malleate (Fig. 1:f); oesophagus with small paired glands; large red cerebral eye; resting egg with fine hairs (Fig. 1:e).

Length: 420–760 μm, foot 80–110 μm, toes 275–320 μm, trophi 25 μm, longest uncus tooth 12 μm, manubrium 18μm.

Distribution: Cosmopolitan, pancontinental in Australia, rare. Warm stenotherm, 11.5–17.0°C, pH 4.8–6.5, conductivity to 1600 μS cm^{-1}. The rotifer may swim between water plants, also jumps by flicking the toes.

Literature: Koste 1978, 1981; Ridder 1981; Koste & Robertson 1983; Koste & Shiel 1987a

Genus *Diplois* Gosse

Diplois Gosse *In* Hudson & Gosse, 1886, Vol. 2, p. 86.

Diplois daviesiae Gosse
FIG. 2:1

Diplois daviesiae Gosse *In* Hudson and Gosse, 1886, Vol. 2, p. 87, Fig. 24:3.

D. phlegraea Troso, 1910, p. 301.

D. sculpturata Daday, 1897, p. 135 (from New Guinea).

Diagnosis: Lorica with three plates; arched dorsal plate divided longitudinally by sulcus; lateral sulci small; foot three-segmented; toes thin; lorica surface smooth, flexible; head short, broad; eye with lens; oesophagus short; stomach compact; gastric glands large.

Length: to 500 μm, width 225 μm, toes 100 μm.

Distribution: May be cosmopolitan in the benthic of freshwater *Sphagnum* pools. Not yet recorded from the Neotropics. Not recorded in this study, but there is an early record from Qld (Thorpe 1887).

Genus *Dipleuchlanis* Beauchamp

Dipleuchlanis Beauchamp, 1910, p. 122.

Dorsal plate narrower than ventral plate; foot three-segemented; toes more or less long, rod-shaped with tapering points occasionally swollen terminally; rami points with minute comb (Fig. 2:2b); unci with 7–10 teeth; gastric glands long in younger individuals, broader and lobed in adult; red cerebral eye. Two variants of a single species *(D. propatula)* are known from Australia; individuals can be discriminated by toe structure. *D. propatula* has toes without a swelling before the points, whereas *D. propatula macrodactyla* has toes with a swelling.

Dipleuchlanis propatula propatula (Gosse)
FIG. 2:2a–f

Diplois propatula Gosse *In* Hudson & Gosse, 1886, p. 87, Fig. 24:2.

Dipleuchlanis propatula (Gosse) after Beauchamp, 1910, p. 122.

Diagnosis: Caudal part of dorsal plate sometimes stretched to rounded point and reaches nearly to end of ventral plate; toes tapering to short point.

Length: 338–508 μm, lorica length to 500 μm; width to 200μm; toes 70–110 μm.

Distribution: Cosmopolitan in littoral, sometimes occurs in plankton of ponds or billabongs. Rare, Vic., N.T. Warm stenotherm, pH 4.5–6.4, also in O_2-poor waters on the surface of mud.

Literature: Koste 1978, 1981.

Dipleuchlanis propatula macrodactyla (Hauer)
FIG. 2:2g

Dipleuchlanis macrodactyla Hauer, 1965, p. 351.

Dipleuchlanis propatula f. *macrodactyla* (Hauer) after Koste, 1978, p. 145.

Diagnosis: Caudal part of dorsal lorica with short paired cuticular projections; toes long.

Length: 128–244 μm, width 69–212 μm, toes 112–168 μm.

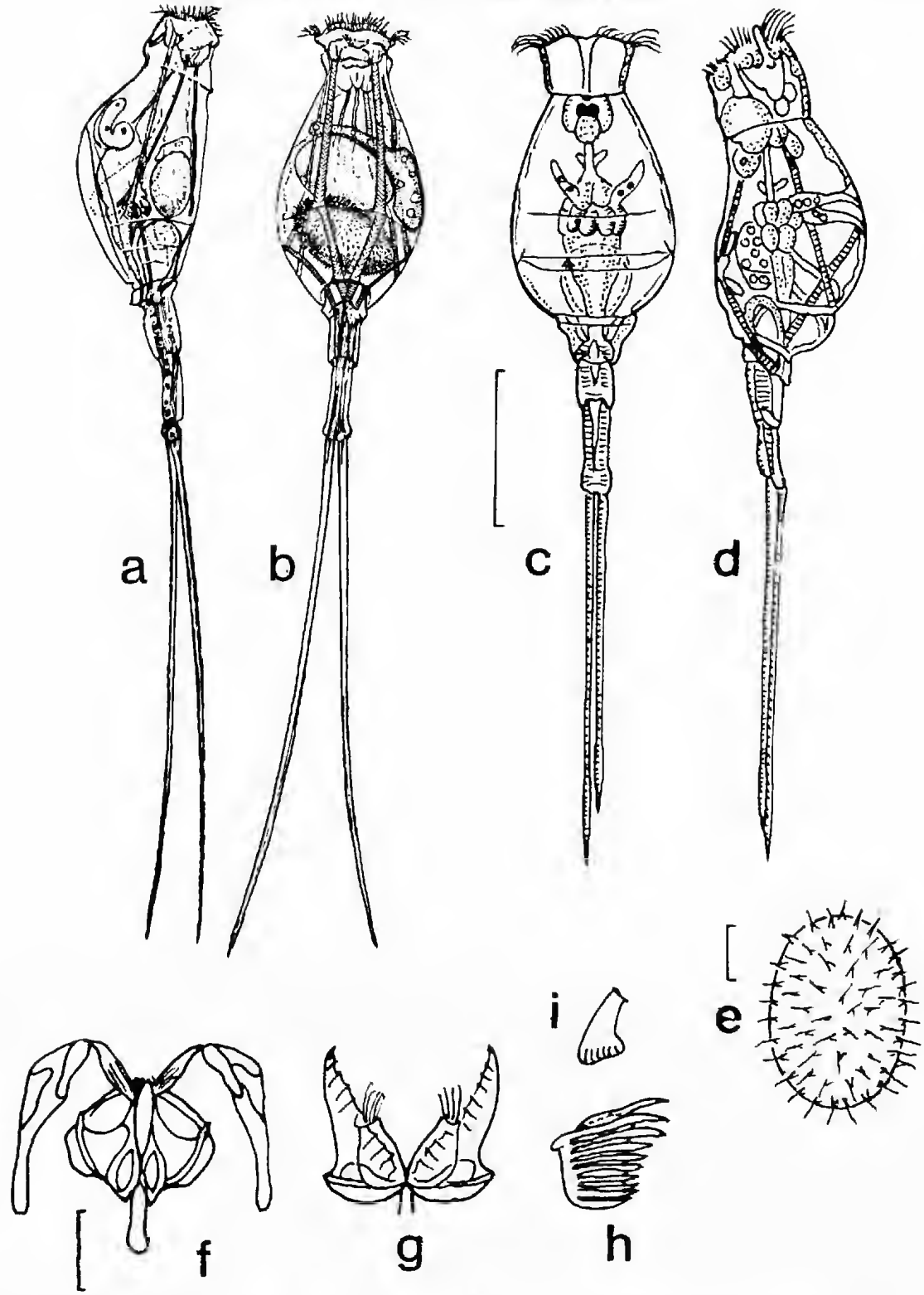


Fig 1: *Manfredium eudactylotum* (Gosse): (a) lateral; (b) ventral; (c) dorsal; (d) lateral; (e) resting egg; (f) trophi; (g) opened rami; (h) uncus; (i) fulcrum. Fig. 1a–d, f–i after Wulfert (1940); e after Koste (1978). Scales lines, top 100 μm (a–d); lower right 20 μm (e); lower left 10 μm (f–i).

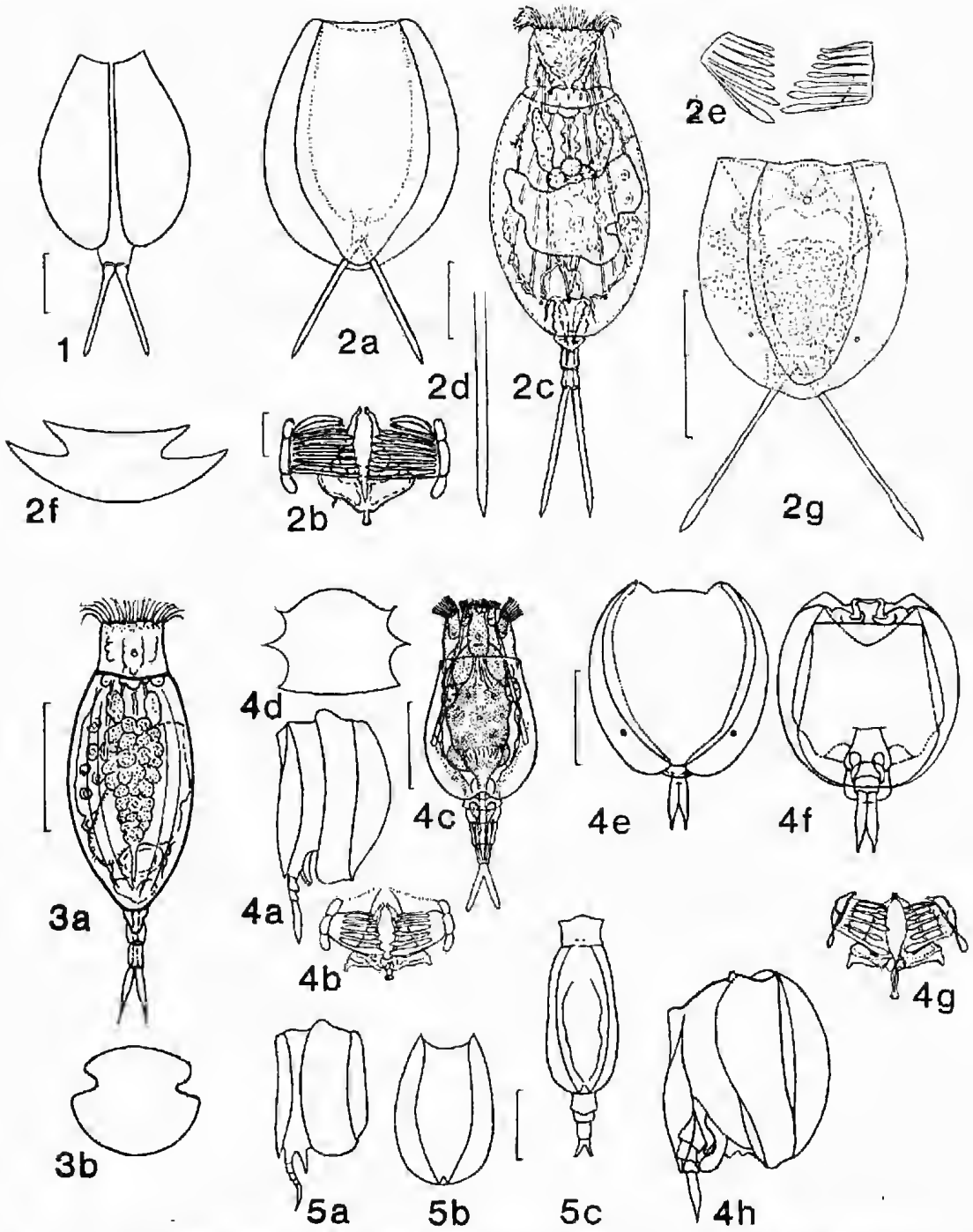


Fig. 2: 1, *Diplois daviesiae* Gosse, dorsal. 2, *Dipleuchlanis propatula propatula* (Gosse): (a) dorsal; (b) trophi; (c) ventral, swimming; (d) toe; (e) unci; (f) cross-section; (g) *D. propatula macrodactyla* (Hauer), dorsal. 3, *D. elegans* (Wierzejski): (a) dorsal; (b) lorica cross-section (cf. *D. propatula*). 4, *Tripleuchlanis plicata plicata* (Levander): (a) lateral; (b) trophi; (c) dorsal, swimming; (d) cross-section; (e) dorsal; (f) ventral; (g) trophi, apical; (h) lateral. 5, *T. plicata ruzelmi* Rodewald: (a) lateral, (b) dorsal, swimming; (c) ventral. Fig. 2:1, after Weber (1898); 2a, b, f, 3a–d, after Myers (1930); 2c, d, 3, after Fadeew (1924); 2g, 3e–g, after Hauer (1965); 5a–c, after Rodewald-Rudescu (1960). Scale lines Fig. 2:1–4, 100μm (adult lorica each number group); 5,50 μm; 2b, 4b, g, 10 μm.

Distribution: Pantropical. N.T., Vic. Water to 32°C, pH 5.4–6.5.
Literature: Myers 1930; Hauer 1965; Koste 1974, 1981; Berzins 1982.

Doubtful or insufficiently described species:

Dipleuchlanis elegans (Wierzejski, 1893) = *Euchlanis propatula elegans* (Fig. 2:3) according to Beauchamp, 1910, p. 122.
Dipleuchlanis conradi Evens, 1947, p. 179, Fig 5.
Dipleuchlanis paludosa Hauer, 1936, p. 139, Fig. 2:12.

Genus *Tripleuchlanis* Myers

Tripleuchlanis Myers, 1930 p. 379.

Lorica ovoid in shape, truncate in front, smoothly-rounded caudally; dorsal and ventral plate nearly of same size, connected by pair of lateral longitudinal sulci. Longitudinal flange of stiffened cuticle extending for entire length between each, giving bellows-like appearance to cross-section. Foot three-jointed, guarded by shield-like process extending downwards from median longitudinal flange; toes short ending in abrupt points; mastax of modified malleate type (Fig. 2:4h); six club-shaped teeth on each uncus; rami triangular with minute denticulate combs at inside of tip; double cerebral eye. A single species, *T. plicata*, with a doubtful variant (*T. plicata* f. *ruzelmi* (Fig. 2:5)) from Romania distinguished on the basis of an elongated dorsal plate, caudally with a rounded notch (Rodewald 1940:88).

Tripleuchlanis plicata (Levander)
FIG. 2:4

Euchlanis plicata Levander, 1894 p. 48.
Tripleuchlanis plicata (Levander) after Myers, 1930, p. 379.

Diagnosis: Lorica stout; foot glands and reservoirs elongated; retrocerebral organ small.

Length: 250–270 μm, dorsal plate 90–130 μm, ventral plate 100–115 μm, toes 25–37 μm.
Distribution: Cosmopolitan; rare in fresh-, more in brackish and marine waters, also in warm springs. Qld, Vic.
Literature: Hauer 1925, Koste 1978.

Genus *Euchlanis* Ehrenberg

Euchlanis Ehrenberg, 1832, p. 13).

Lorica transparent with oval or ovate outline; dorsal plate arched, convex, sometimes with median keel or lateral wings, larger than ventral plate, variable in height and shape; ventral plate caudally somewhat indented, nearly flat. Two plates connected by thin, flexible cuticle forming longitudinal sulci. Foot with two or three joints; toes long or short, sword-shaped or parallel-sided, with sharp tips. Paired long setae situated on dorso-distal portion of foot-segments (Fig. 3a:ss). Corona of family type (Fig. 3d); long sensory bristles and cilia in tufts and solitary on apical field. Trophi (Fig. 3e, f) modified malleate; fulcrum (Fig. 3f:fr) broad, pointed rami (ra) with and without minute comb; uncus with main and variable number of accessory teeth. Brain with large cerebral eye (Fig. 3b ey) behind large mastax. Large retrocerebral organ present (Fig. 3b:re), with subcerebral glands. Dorsal antenna large; lateral antenna (Fig. 3b:la) with sensillae tufts on small tubules. Stomach sometimes with sacculi but not constant between species. Excretory organ with large contractile bladder (Fig. 3a,b:bl). Vitellarium with eight large nuclei. Male thinly loricate (Fig. 3l:m) with reduced alimentary tract; protonephridia present. Foot with two to three joints; two long sensory bristles on terminal joint. Toes short. Dark resting eggs may be attached to plants (Fig. 3h,j).

Euchlanis species are littoral rotifers living among aquatic plants, but in the pelagial they occur in eutrophic lakes and ponds at Cyanophyta maxima, especially of *Gloeotrichia*, the main food of *Euchlanis dilatata* (Ruttner-Kolisko 1974). Other foods consists of diatoms, desmids, other algae and detritus.

The taxonomy of the different species is difficult; even within the same population lorica shape and cross-section is variable. The shape of the anterior margin of both plates is of little value in the determination. Most useful is trophi structure, which is species-specific. *Euchlanis* should not be pressed by a coverslip. See for example *E. meneta* cross-sections and the different forms of *E. dilatata*.

Key to Species of the Genus *Euchlanis*

1. Cross section of lorica more or less arched to semi-circular 2
   Cross section of lorica triangular, dorsal plate with high keel 10
2(1). Posterior edge of dorsal lorica with distinct notch or embayment (cf. Fig. 7:1k; Fig. 8:2a) 6
   Notch absent, or only shallow emargination (cf. Figs 4:3b, 6:3) 3
3(2). Ventral plate present 4
   Venter membranous or rudimentary 5
4(3). Ventral plate ca. ½ dorsal plate width; wing-like lateral expansions of dorsal lorica margin (Fig. 4:3b) ..... *E. alata* Voronkov
   Ventral plate ca. ⅓ dorsal plate width, constricted at posterior end; no expanded margins (Fig. 6:3) ..... *E. lyra* Hudson
5(3). Lateral constrictions in medial dorsal lorica; flanged lateral margins (Fig. 8:3) ..... *E. pyriformis* Gosse
   Dorsal lorica not constricted, lateral margin not flanged (Figs 4:3, 4:4) ..... *E. deflexa* Gosse
6(2). Cuticular shield-like process just below caudal part of dorsal plate (Fig. 7:l) ..... *E. meneta* Myers
   Shield-like process lacking 7
7(6). Ventral plate rudimentary; longitudinal sulci absent; toes very long (>100 μm), slender (Fig. 4:2) ..... *E. calpidia* Myers
   Ventral plate well developed 8

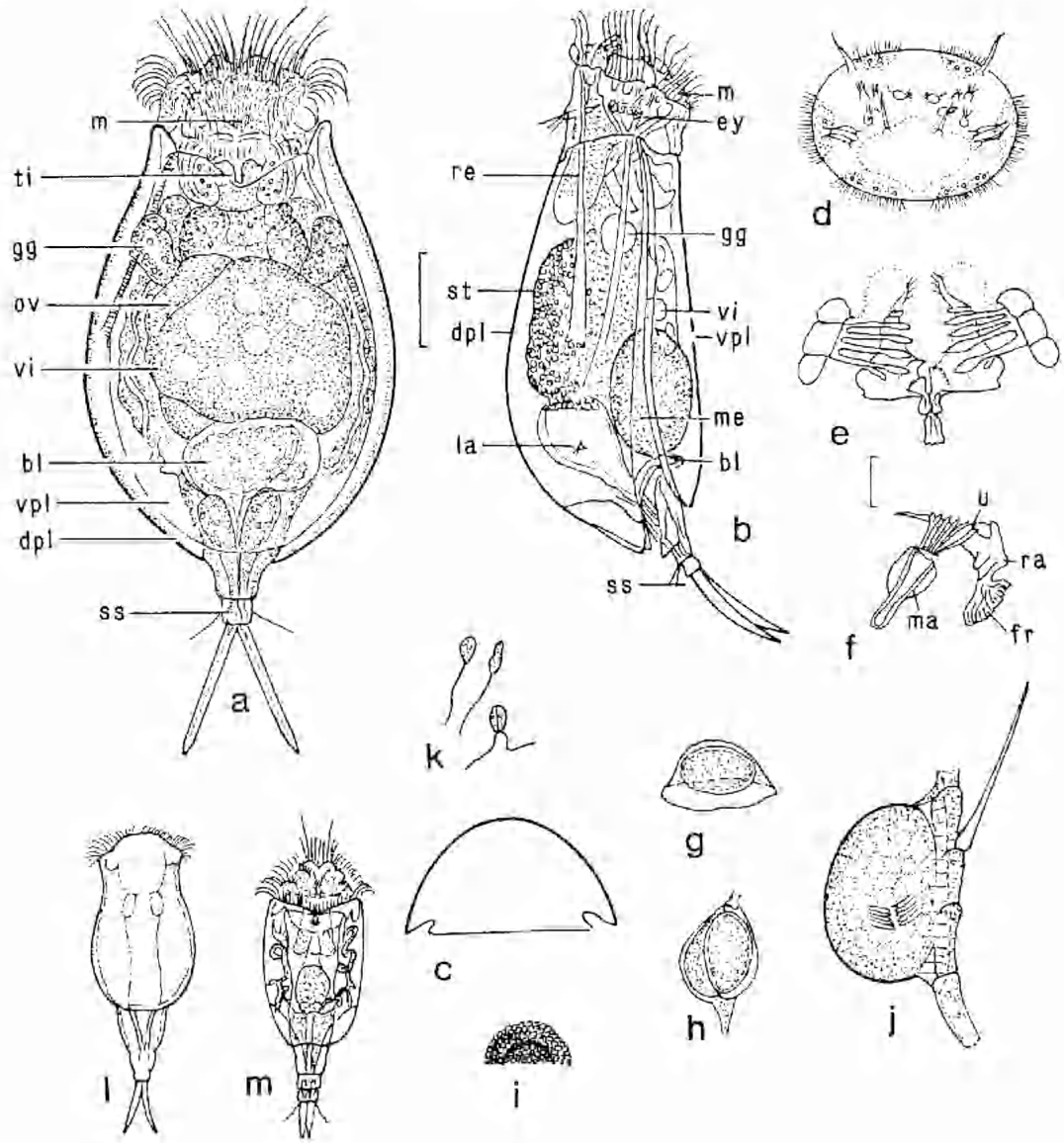


Fig. 3: *Euchlanis dilatata dilatata* Ehrenberg: (a) ventral; (b) lateral; (c) cross-section; (d) apical field; (e) trophi; (f) trophi, lateral; (g) *E. triquetra,* amictic egg; (h) mictic egg; (i) *E. dilatata,* mictic egg; (j) subitaneous egg; (k) sperm; (l) male; (m) *E. deflexa,* male. (Key to a,b: bl = bladder; dpl = dorsal plate of lorica; ey = eye; gg = gastric glands; la = lateral antenna; m = mouth; me = membrane; ov = ovary; rc = retrocerebral sac; st = stomach; ss = sensorybristles; vi = vitellarium; vpl = ventral plate of lorica. Key to f: ma = manubrium; fr = fulcrum; ra = ramus; u = uncus). Fig. 3a, c, j, after Koste (1978); b, after Beauchamp (1965); d, after Remane (1933); e, after Hauer (1930); f, after Voigt (1957); g, h, after Wesenberg-Lund (1929); i, after Kozar (1914); k, after Ruttner-Kolisko (1972); l, after Wulfert (1956); m, after Leissling (1924). Scales lines, top, a–d, g–m, 50μm; e, f, 10 μm.

8(7). Dorsal lorica with winglike lateral extensions deflected ventrally at tips (Fig. 8:2)*E. phryne* Myers
No lateral extensions of dorsal lorica 9

9(8). Foot and toes slender; toes ⅓ length of dorsal plate, blade-like, fusiform (Fig. 5:1b)*E. dilatata* Ehrenberg
Foot and toes stout; toes ¼ length of dorsal plate toes dilated distally for ⅓ length and constrict to acute points (Fig. 8:1) . . . . . *E. oropha* Gosse

10(1). Ventral plate completely developed, lateral sulci present (Fig. 6:1) . . . . . *E. incisa* Carlin
Ventral plate reduced to thin hyaline membrane; wide dorsal plate flanges (Fig. 8:1c–e . . . . . *E. triquetra* Ehrenberg

Euchlanis alata Voronkov
FIG. 4:1

Euchlanis alata Voronkov, 1912, p. 210, Figs 2,3.
Diagnosis: Shape of body ovoid; dorsal plate without terminal notch or embayment, but may have lateral wing-like extensions (see Fig. 4:1b, d). Wingless individuals easily mistaken for *E. lyra* or *E. deflexa*. Intermediate forms common. Ventral plate elongate, relatively narrow, but without constriction before end as in *E. lyra*. Foot two-segmented and robust; toes stout and fusiform. Tips of rami incurved with pair of finely denticulate combs; four stout teeth in each uncus with several accessory teeth.

Length of dorsal plate 260–360 μm; ventral plate width 102–156 μm; toes 70–98 μm; toes width 12–20 μm.
Distribution: Nearctic and Palearctic, in acid boreal waters, littoral and psammal. Not yet recorded from Australia.
Literature: Pejler 1962; Koste 1978; Chengalath & Koste 1983.

Euchlanis calpidia Myers
FIG. 4:2

Euchlanis calpidia Myers, 1930, p. 371, Pl. 20, Figs 1–8.
Diagnosis: Dorsal plate round, or highly domed ("obscure triradiate", i.e. helmet-like) in cross section. Middle portions of lateral edges straight or pinched, extending downward below venter; ventral plate rudimentary (cf. *E. deflexa* and *E. pyriformis*), rudiments connected with dorsal plate by flexible membrane; lateral sulci absent; foot two-jointed, slender; toes very long, parallel-sided with abrupt point. Trophi characterized by five slender paired teeth in unci with two or three accessory teeth beside smallest. Tips of rami without minute denticulate comb. Trophi similar to those of *E. deflexa* and *E. pyriformis*. *E. calpidia* distinguished by presence of distinct posterior notch at end of dorsal plate, and by relatively long toes.

Length of dorsal plate 280–400 μm; lorica width 220–397 μm; toes 120–135 μm; toe width to 18 μm.
Distribution: Nearctic, Palearctic (Europe to Far East). Single record from a Goulburn R. billabong near Seymour, Vic. 22°C, pH 7,3, DO 8,0 mg l^{-1}.
Literature: Hauer 1936; Wang 1961; Kutikova 1970; Koste 1978.

Euchlanis deflexa Gosse
FIG. 4:3

Euchlanis deflexa Gosse, 1851, p. 200.
Dapidia deflexa (Gosse) in Myers 1930, p. 369, Pl. 21, Figs 1–5.
(*Dapidia* = *Euchlanis* after Carlin, 1939, p. 16).
Diagnosis: Body resembles arc of circle in cross-section; dorsal plate ovoid, without distinct posterior notch, sometimes with shallow emargination. Lateral edges of dorsal plate connected by flexible membrane somewhat thickened in position occupied by ventral plate in other *Euchlanis*. Posterior portion of this area more hardened as rudimentary ventral plate. No longitudinal sulci present. Foot stout and two-jointed, long setae on dorsal end of first joint; trophi with five long teeth on each uncus, clubbed at tips, with 2–3 accessory teeth; rami drawn out to long tips, minute inside combs lacking (Fig. 4:3f).

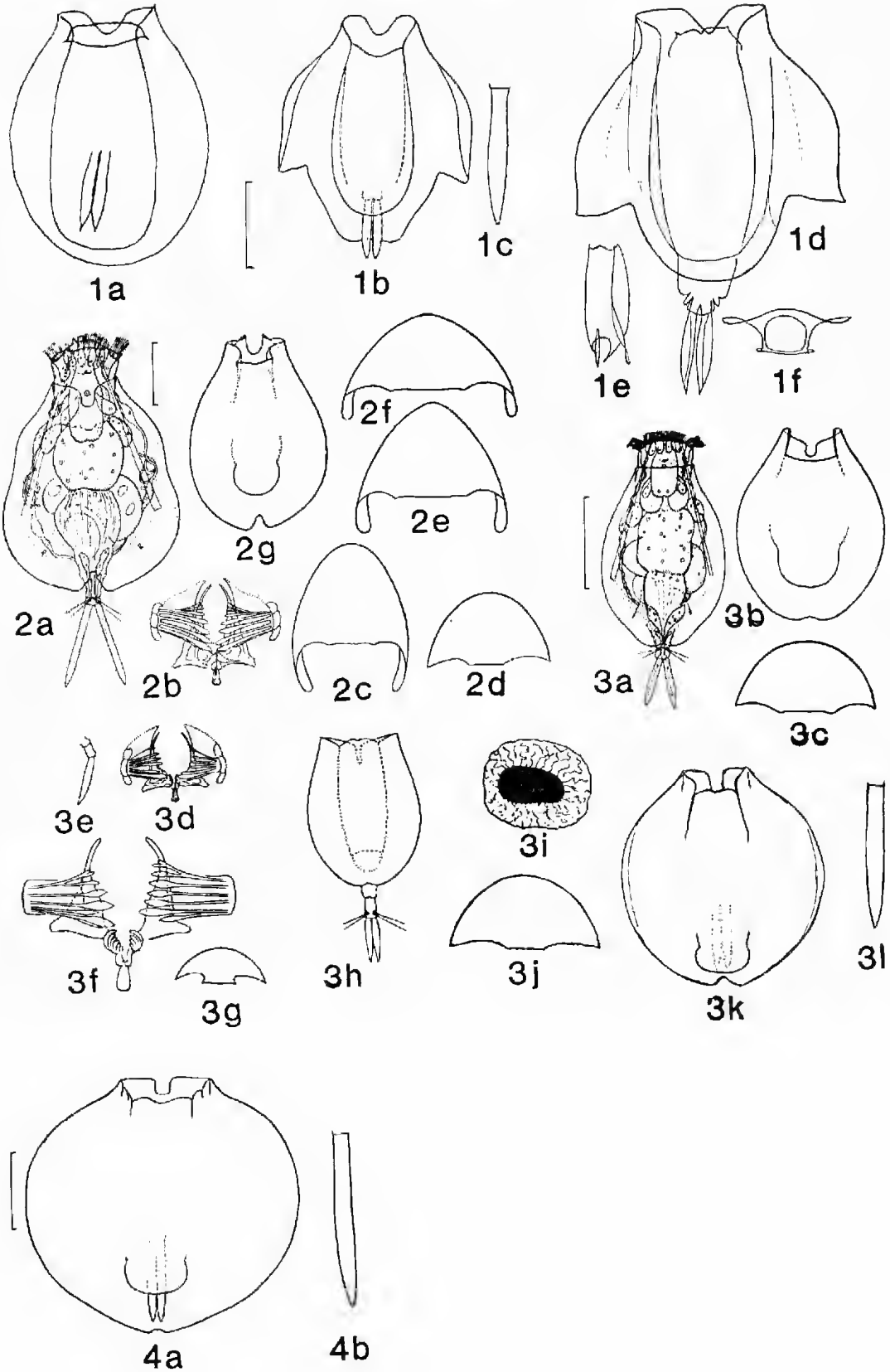
Length of dorsal plate 190–350 μm, width 140–240 μm, toes 55–100 μm, toes to 15 μm wide, subitaneus egg 180x89 μm.
Distribution: Cosmopolitan in the littoral, occasionally in the pelagial. Rare; N.S.W., Tas., Vic., W.A. There may be local variants, e.g. the Tasmanian form closely resembles *E. deflexa larga* (Fig. 4:4), described from Lake Balkasch, Siberia (Kutikova 1959). 14.0–22.0°C, pH 6.0–7.7, DO 8.0–8.6 mg l^{-1}, <70 μS cm^{-1}.
Literature: Evans 1951; Koste 1978; Shiel & Koste 1979.

Euchlanis dilatata Ehrenberg
FIGS 3, 5:1

Euchlanis dilatata Ehrenberg, 1832, p. 131, Fig. 4:3.
Diagnosis: General body shape ovoid, truncate anteriorly, rounded posteriorly; dorsal plate variable in height and shape of cross-section, varying from low arc of circle to high triangle; ventral plate almost as large as dorsal; longitudinal sulci not deep and narrow (Fig. 5:1c). Posterior dorsal plate divided by deep elongate notch of variable form, cf. f. *lucksiana* (Fig. 5:4), f. *unisetata* (Fig. 5:3) or f. *larga* (Fig. 5:5). Foot slender and two-jointed; paired setae on distal margin of first segment; toes mostly parallel-sided, tapering terminally to sharp tip. Unci of trophi with four opposing teeth; ventral large teeth each have rudimentary tooth; tips of rami with inner minute denticulate comb; retrocerebral sac large (Fig. 3b:re, cf. also Fig. 5:4i); brain with red eye on dorsal side.

Infraspecific forms are described exclusively according to differences in the shape of the lorica and cross sections, however research by Parise (1963) suggests that different morphological types are correlated with ecological differences. This also may apply to some distinguished species; *E. parva* Rousselet, for example, resembles *E. dilatata* and is distinguished from it by smaller size and long slender toes. All known measurements fall within the range of variation of *E. dilatata;* it is seen as an ecotype of *E. dilatata.*

Lorica length 140–320 μm, dorsal plate width 100–255 μm, ventral plate 95–172 μm, toes 50–100 μm, posterior notch 12–61 μm deep; male 115–148


1a
1b
1c
1d
1e
1f
2a
2b
2c
2d
2e
2f
2g
3a
3b
3c
3d
3e
3f
3g
3h
3i
3j
3k
3l
4a
4b

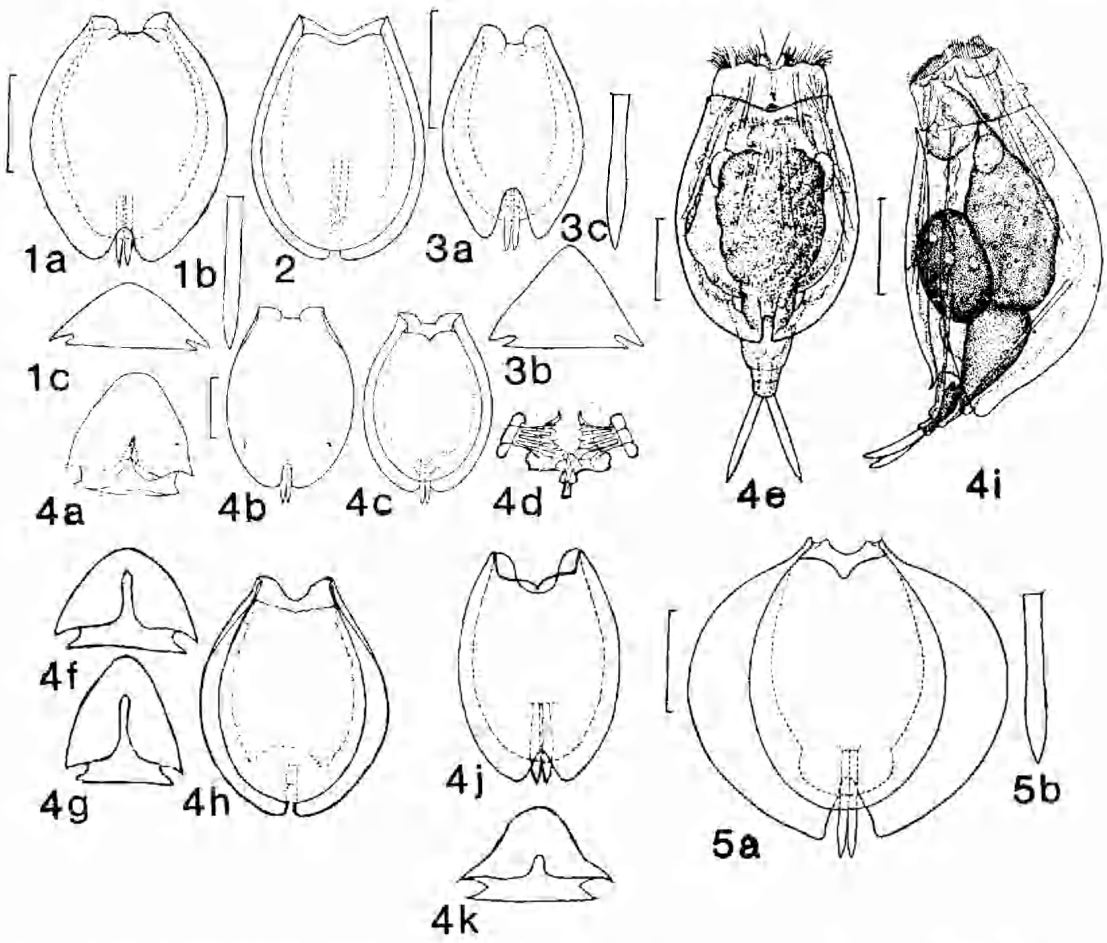


Fig 5: 1, *Euchlanis dilatata dilatata* Ehrenberg: (a) dorsal; (b) toe; (c) cross-section. , *E. dilatata macrura* (Ehrenberg): ventral. 3, *E. dilatata* f. *unisetata* (Leydig): (a) dorsal; (b) cross-section; (c) toe. 4, *E. dilatata* f. *lucksiana* (Hauer): (a) cross-section; (b) dorsal; (c) ventral; (d) trophi, apical; (e) swimming; (f–g, k) cross-sections; (h, j) different lorica forms; (i) *e. dilatata,* lateral, swimming. 5, *E. dilatata larga* Kutikova: (a) dorsal; (b) toe. Fig: 1:a–c, 2, 3a–c, 5a, b, after Kutikova (1970); 4a–d, j, k, after Hauer (1930); 4e–i, after Myers (1930). Scale lines 100 μm.

Fig. 4: 1, *Euchlanis alata* Voronkov: (a) without wings, ventral; (b) with wings, ventral; (c) toe; (d) ventral; (e) habit, lateral; (f) cross-section. 2, *E. calpidia* (Myers): (a) dorsal, swimming; (b) trophi, apical; (c–f) cross-sections; (g) lorica, ventral. 3, *E. deflexa* Gosse; (a) dorsal; (b) lorica, ventral; (c, g, j), cross-sections; (d) trophi, apical; (e) toe, lateral; (f) other trophi; (h) dorsal; (i) resting egg; (k) lorica, broad form, ventral; (l) toe. 4, *E. deflexa larga* (Kutikova): (a) lorica, ventral; (b) toe. Fig. 4:1a, d–f, after Yamamoto (1953); 1b, c, 3j, l, 4a, b, after Kutikova (1970); 2, 3a–e after Myers (1930); 3f–h, after Donner (1964). Scales lines 100μm (adults lorica in each number group).

μm, toes 34–240 μm. [*E. parva* Rousselet, 1892: dorsal plate length 140 μm, width 100 μm, ventral plate length 125 μm, width 75 μm, toes 70 μm, depth of posterior notch 50 μm].

Distribution: Cosmopolitan in fresh and brackish water: pH 4–10, Cl 140 g l^{-1} (Koste 1978). The most common and widely tolerant euchlanid in inland waters; pancontinental, including Tasmania. 8.0–29.9°C, pH 5.44–7.9, DO 3.6–13.8 mg l^{-1}, 23–1600 μS cm^{-1}, 2–235 NTU.

Literature: Myers 1930; Hauer 1935; Kutikova 1970; Ridder 1972; Koste 1978; Shiel & Koste 1979; Koste & Shiel 1980.

Euchlanis incisa Carlin
FIG. 6:1

Euchlanis incisa Carlin, 1939, p. 17.
Euchlanis triquetra Hudson & Gosse, 1889, Pl. 23, Fig. 4.

Diagnosis: Body ovoid in shape, truncate in front with variable anterior notch; dorsal plate triradiate in cross-section with median keel extending from neck to angle of posterior v-shaped notch. Ventral plate completely developed. Longitudinal deep sulci connect both plates; foot two-jointed, setae on first foot joint; toes slender, fusiform; trophi (Fig. 6:1e, h) with five teeth on each uncus. First and last (Fig. 6:1h) have accessory shorter tooth; minute combs on rami tips. Male (Fig. 6:1i) with normal anatomy for genus (cf. Fig. 3:1).

Length of dorsal plate 210–270 μm, ventral plate 180–240 μm, lorica width to 240 μm, toes 70–85 μm; male 145 μm, toes 26 μm.

Distribution: Cosmopolitan in the littoral, occasionally in the pelagial of shallow ponds and billabongs. Rare, N.T., Tas., Vic. 13.5–29.9°C, pH 5.3–7.9, DO 5.45–8.2 mg l^{-1}, 23.0–80.2 μS cm^{-1}, 2.0 NTU.

Comment: A variant, *E. triquetra mucronata* (= *E. incisa mucronata*) (Fig. 6:2a, b) described by Ahlstrom (1934) from the Neotropics may be an ecotype; it resembles *E. incisa* and may co-occur. The dorsal plate has an elongated keel. Length of dorsal plate to 320 μm, lorica width to 252 μm, height to 120 μm; toes to 120 μm. Not yet recorded from Australia.

Literature: Myers 1930; Wulfert 1956; Koste 1974, 1978, 1981; Shiel & Koste 1979; Berzins 1982.

Euchlanis lyra Hudson
FIG. 6:3a–j

Euchlanis lyra Hudson *In* Hudson & Gosse, 1886, p. 89, Fig. 23:1.
E. myersi Kutikova, 1959, p. 223.

Diagnosis: Body elongate and ovoid; cross-section resembles arc of circle; lateral sulci present; dorsal plate without posterior notch; ventral plate totally developed, somewhat constricted caudally; foot slender, two-jointed; paired long setae on first foot-joint; trophi with five paired unequal teeth, with two or three accessories; rami tips with minute inside comb. Length of toes variable.

Length of dorsal plate to 335 μm, ventral plate 302 μm, lorica width 110–180 μm, toes 76–90 μm, toe width 14–16 μm.

Distribution: Cosmopolitan in inundation areas, also in periphyton. Single record from L. Mulwala, Vic. 12.0°C, pH 7.5, DO 10.7 mg l^{-1}, 46 μS cm^{-1}, 17.5 NTU. Variants are known in the northern hemisphere, e.g. *E. lyra myersi* (Kutikova 1959: 223) (Fig. 6:4) a Palearctic subspecies with long slender toes (86–107 μm long, 7–8 μm wide) and *E. lyra larga* (Fig. 6:3k, l) (Kutikova 1959) from N. Siberia. Variants are not recorded from Australia.

Literature: Myers 1930; Pejler 1962; Koste 1978; Shiel & Koste 1979.

Euchlanis meneta Myers
FIGS 7:1,2

Euchlanis meneta Myers, 1930, p. 378, Pl. 19, Figs 5–8.
Euchlanis oropha Lucks, 1912, p. 105, Fig. 31.
Euchlanis proxima Myers, 1930, p. 377, Pl. 19, Figs 1–4.

Diagnosis: Shape nearly ovoid; well-developed ventral plate almost as large as dorsal plate; cross-section semicircular arched but also roughly triradiate; dorso-ventral width of lateral sulci (relatively) uniformly wider than in any other congener; cuticular shield-like process beneath posterior notch above first foot joint; posterior notch of dorsal plate very deep and often large (Fig. 7:1k); foot two-jointed; toes very long and slender, sometimes with minute claw at tips. Male colourless, with short toes; dorsal and ventral plate still conspicuous; brain long with red eye; two sensory hairs on tiny tubules in apical field, as in female. Trophi (Fig. 7:1e) with four main teeth, accessories not visible; minute denticulate combs on inside of rami tips (Figs 7:1e, 2d).

Length of dorsal plate 105–173 μm, width 80–140 μm, depth of posterior notch 35–45 μm, width of ventral plate 50–90 μm, toes 60–75 μm, width of toes 3.5 μm. Male total length 170 μm, toes 25 μm.

Distribution: Cosmopolitan, mostly in acidic waters; rare in submerged *Sphagnum;* N. America, W. Germany, N.S.W., N.T., Vic., W.A. 10.0–29.9°C, pH 5.3–7.4, DO 5.45–10.1 mg l^{-1}, 20–523 μS cm^{-1}, 22 NTU, alk. 2.6–2.7 mg l^{-1}.

Literature: Myers 1930; Hauer 1935 (*proxima*); Wulfert 1951; Pejler 1962; Berzins 1963, 1982; Koste 1978, 1981; Koste & Shiel 1980.

Euchlanis oropha Gosse
FIG. 8:1

Euchlanis oropha Gosse, 1887, p. 5, Fig. 2:16.
non *Euchlanis oropha* Lucks, 1912, p. 105, Fig. 31.

Diagnosis: Resembles *E. dilatata* but usually smaller, with stouter foot and more robust, differently-shaped fusiform toes; lateral antennae situated in cavities beside somewhat keeled end of dorsal plate; trophi construction as *E. dilatata* (cf. Figs 3e, 5:4d). Comb-like processes on inside of each ramus tip; four opposed club-shaped functional teeth.

Length of dorsal plate 164–266 μm, width 127–172 μm, ventral plate length 123–225 μm, toes 49–78 μm, width 10–14 μm, posterior notch 25–29

Distribution: Cosmopolitan. N.T., Qld, Vic. 8.0–18.5°C, pH 4.8–8.4, DO 8.4–10.0 mg l^{-1}, 67–400 μS cm^{-1}, 4.5–160 NTU.

Literature: Myers 1930; Kutikova 1959; Koste 1978; Shiel & Koste 1979; Berzins 1982.

Euchlanis parameneta Berzins
FIG. 7:3

Euchlanis parameneta Berzins, 1973, p. 126, Figs. 4, 5.

Diagnosis: Resembles *E. meneta* (see above). Toes with pseudoclaws; anterior margin of dorsal plate with two short keels.

Length of dorsal lorica 95–104 μm; ventral plate 70–72 μm; width, dorsal 70–75 μm, ventral 50–55 μm; anterior margin width 35 μm, caudal opening 26–30 μm long x 18–25 μm wide; toes 45–50 μm.

Distribution: Recorded from New Zealand, not yet known from Australia.

Euchlanis phryne Myers
FIG. 8:2

Euchlanis phryne Myers, 1930, p. 372, Pl. 14, Fig. 1; Pl. 15, Figs 1–4.

Diagnosis: Dorsal lorica oval, with slight constriction of median lateral margin; deep inverted U-shaped caudal notch almost as long as toes; stiffened ventral plate connected to dorsal plate by longitudinal sulci; toes short, fusiform, ca. ¼ length of dorsal plate; trophi with four club-shaped teeth on each ramus; rami with fan-shaped denticulate combs on inner distal margins.

A superficial resemblance to *E. pyriformis* and *E. calpidia* was noted by Myers (1930), and Koste (1978) considered *E. phryne* a possible variant of *E. calpidia* or *E. dilatata*. Comparison of lorica morphology of the species above, particularly cross-sections, and differences in trophi structure, indicates that *E. phryne* is a distinct species.

Length of dorsal plate 225 μm, ventral plate 210 μm, dorsal width 180 μm, ventral plate width 150 μm, toes 65 μm.

Distribution: North America (Maine); single locality, a billabong of the Goulburn R. near Seymour, Vic., in spring 1976 and again in summer 1978, 17.0–22.0°C, pH 7.1–7.4, DO 8.7–9.8 mg l^{-1}.

Comment: The above anomalous distribution is noteworthy: *E. phryne* is one of several rotifer and microcrustacean species recorded from Goulburn River billabongs with similar disjunct distributions (Shiel 1976 and unpublished data; Koste 1979). The importation of heavy dam-building machinery by the Utah Construction Company in the mid-1950's (during the construction of Eildon Dam) is implicated as a possible source of transport of resting eggs/ephippia. Populations have become established in sheltered billabongs downstream of the dam site.

Euchlanis pyriformis Gosse
FIG. 8:3

Euchlanis pyriformis Gosse, 1851, p. 201.
Dapidia pyriformis Myers, 1930, p. 370, Fig. 15:5–7.

Diagnosis: Shape nearly circular, may have slight emarginations instead of caudal notch; lateral margins turned downwards, occasionally pinched in the middle; ventral plate rudimentary, only developed posteriorly; no lateral sulci; foot two-jointed; two long pairs of setae on dorsal side of the first foot segment; toes relatively short; trophi resembles that of *E. deflexa* (cf. Fig 4:3f).

Length of dorsal plate 285–320 μm, width 275–315 μm, toes 80–85 μm, toe width 10–13 μm.

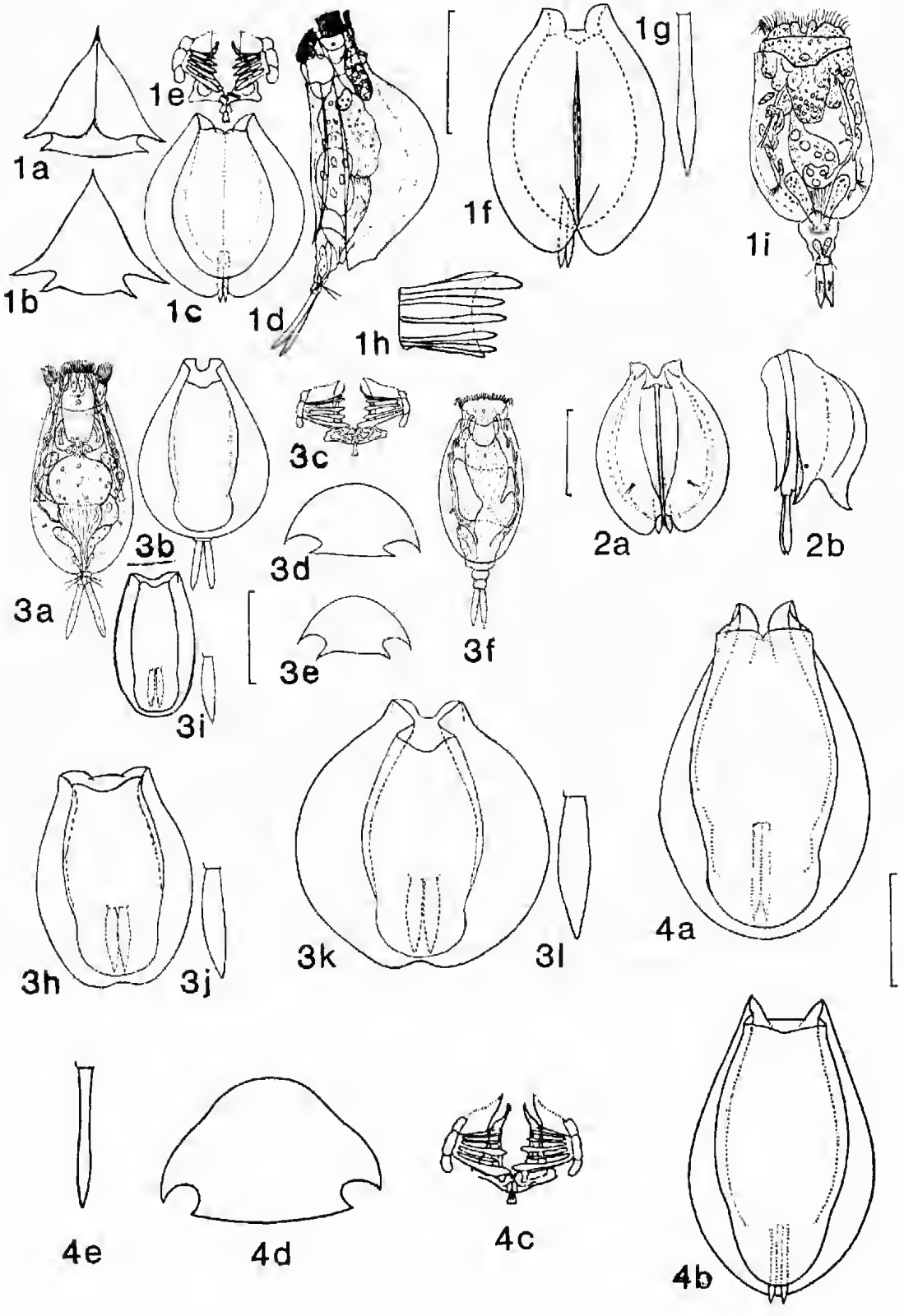
Distribution: Cosmopolitan in the littoral, occasionally pelagial. Vic., Tas.

Literature: Koste 1978; Berzins 1982; Shiel & Koste 1985.

Euchlanis triquetra Ehrenberg
FIG. 9:1

Euchlanis triquetra Ehrenberg, 1838, p. 461, Fig. 57:8.
E. pellucida Harring, 1921, p. 6, Fig. 2.
E. langobardica Manfredi, 1927, p. 24, Fig. 7b.
Dapidia carinata Carlin-Nilsson, 1934, p. 6, Fig. 2.
D. lata Carlin, 1939, p. 16.
Euchlanis triquetra pterigoidea Crese, 1955, p. 60, Figs 15, 19.
non-*E. triquetra* after Ruttner-Kolisko, 1972, p. 182, Fig. 11b.

Diagnosis: Body in dorsal view circular, sometimes somewhat elongated (Fig. 9:1); triangular with a high keel in cross-section; median keel extends from neck to caudal region; dorsal plate laterally with wide flanges (Fig. 9:1c–e); no ventral plate, no posterior notch, no lateral longitudinal sulci; some specimens with semicircular ventral line over base of toes; foot obscurely two-jointed; toes long, slender, nearly straight, ending in abrupt points; most loricas very transparent with coloured inner organs (retrocerebral sac dark, mastax yellow, stomach olive green, yellow or brownish). Male (Fig. 9:3h,i) with cuticular plates and dorsal keel. Trophi cf. Fig. 9:1j–n; tips of rami with minute combs (Fig. 9:1j–k).


1a
1b
1e
1c
1d
1h
1f
1g
1i
3a
3b
3i
3c
3d
3e
3f
2a
2b
3h
3j
3k
3l
4a
4e
4d
4c
4b

Lorica length 300–710 μm, width to 540 μm, toes 90–15 μm, lorica height to 300 μm, trophi: rami 40 μm, fulcrum 32 μm, manubria 50 μm.

Distribution: Cosmopolitan in the littoral, sometimes pelagic in shallow waters. N.S.W., Qld, N.T., Vic.

Literature: Pejler 1962; Koste 1978, 1981; Shiel & Koste 1979; Berzins 1982.

The following species are not considered here:

E. arenosa Myers, 1936, known only from N. America and ?Volga;

E. bioculata Issel, 1901 (*nomen nudem*, name published without description, and apparently later synonymized with *E. plicata* Levander by Issel (1906). Incorrectly cited in Voigt (1957) and Koste (1978);

E. callysta Myers, 1930 (Fig. 9:4) is possibly a juvenile form of *E. triquetra*. Only known from the Nearctic. Length of dorsal plate 170 μm, lorica width 80 μm, toes 50 μm. (Myers, 1930; Koste, 1978);

E. callimorpha Berzins, 1957 (Fig. 9:2) resembles *E. incisa*, only known from Gambia, W. Africa;

E. contorta Wulfert, 1939, known only from central Germany and the Volga estuary;

E. dapidula Parise, 1966, see Koste 1978 (misquoted as Parise, 1963). Doubtful species;

E. hyphidactyla Parise, 1963, see Koste 1978. Doubtful species.

E. ligulata Kutikova & Vassileva, 1982, endemic in Lake Baikal;

E. mamorokuensis Berzins, 1973 (Fig. 9:3), recorded from Madagascar;

E. mikropous, Koch-Althaus, 1962; recorded only from central Germany;

E. pannonica Bartsch, 1877, known only from Hungary, single record;

E. perpusilla Ridder, 1977, known only from the Caribbean;

E. turfosa (Rodewald, 1940), known only from Romania.

Family Mytilinidae Bartos

Loricate rotifers; cross-sections of lorica mostly triangular or nearly rhombic; ventral plate and dorso-lateral plates firmly fused; long dorsum with or without sulcus, latter common with double keel; three or less foot sections; toes pointed, straight or slightly curved ventralwards; malleate trophi. All species littoral and benthic, occasionally (but rarely) in the plankton. Two genera (see Bartos 1959, Kutikova 1970, Koste 1978).

Key to genera of Mytilinidae

1. Lorica thin or rigid with dorsal sulcus and double keel; lorica unornamented; toes long ..... *Mytilina* Bory de St Vincent
   Lorica without dorsal sulcus, one strong keel; lorica ornamented with distinct pattern and cavities; toes short ..... *Lophocharis* Ehrenberg

Genus *Mytilina* Bory de St Vincent

Mytilina Bory de St Vincent, 1826, p. 87 (=*Salpina* Ehrenberg, 1830, p. 46 = *Diplax* Gosse, 1851, p. 201 = *Diplacidium* Lauterborn, 1913, p. 483).

Two recognized form-series ("Formenkreise"). One series strongly loricate, usually with variable stiff anterior and posterior spines; anterior margin of lorica generally granulated; toes stiff and sword-shaped. Second group thinly loricate without anterior spines (except *M. acanthophora*, (Fig. 10.1, 2); anterior margin not granulate, toes mostly long and slightly curved, flexible.

Key to Species of the Genus *Mytilina*

1. Lorica stout, anterior margin granulated, toes sword-shaped 2
   Lorica thin, anterior margin not granulated, toes long and curved 3
2(1). Anterior lorica margin with two short dorsal and two short ventral spines. . *M. mucronata* Muller
   Anterior lorica margin with only two ventral spines ..... *M. ventralis* (Ehrenberg)
3(1). Ventral margin of lorica with variable projections ..... *M. acanthophora* Hauer
   Ventral anterior margin without projections. . . 4
4(3). Toes with claws 5
   Toes without claws 6
5(4). Head part loricate; 3 foot segments ..... *M. crassipes* (Lucks)
   Head part illoricate; 2 foot segments ..... *M. unguipes* (Lucks)
6(4). Toes relatively short; anterior margin of lorica with folds ..... *M. bisulcata* Lucks)
   Toes long, straight, anterior margin without folds (resembles *M.acanthophora*). *M. trigona* (Gosse)

Mytilina acanthophora Hauer
FIGS 10:1,2

Mytilina acanthophora Hauer, 1938, p. 550, Figs 73a–c.

Diagnosis: Dorsal lorica strongly arched, granulated; ventral lorica flattened, with depression beneath head opening; triangular lorica projections flank medioventral head aperture (Fig. 10:1b); shield-like projection over two-segmented foot; toes long, pointed.

Length: 135–253 μm (total); to 150 μm (lorica); height to 92 μm; width to 64 μm; toes 90–94 μm. An unusually large specimen from Lago Grande, Amazonia had the following measurements (sequence as above): 342, 198, 125, 137, 140–144 μm (Koste unpubl.).

Distribution: Probably pantropical in polysaprobic waters. Not yet recorded from Africa. Occasionally

Fig. 6: 1, *Euchlanis incisa* Carlin: (a, b) lorica cross-sections; (c) ventral; (d) lateral, swimming; (e) trophi, apical; (f) dorsal; (g) toe; (h) uncus; (i) male. 2, *E. incisa mucronata* (Ahlstrom): (a) dorsal; (b) lateral. 3, *E. lyra* Hudson: (a) dorsal; (b) ventral; (c) trophi, apical; (d, e) cross-sections; (f) dorsal, swimming; (g, h) lorica, ventral; (i) toe; (j) toe; (k) *E. lyra larga* (Kutikova), ventral; (l) toe. 4, *E. lyra myersi* (Kutikova): (a) ventral; (b) another form, ventral; (c) trophi, apical; (d) cross-section; (e) toe. Fig. 6: 1a–e, 3a, b, 4a–d, Myers (1930); 1f, g, 3c–l, 4e, after Kutikova (1970); 2a, b, after Koste (1974). Scales lines 100 μm (adult lorica in each number group).

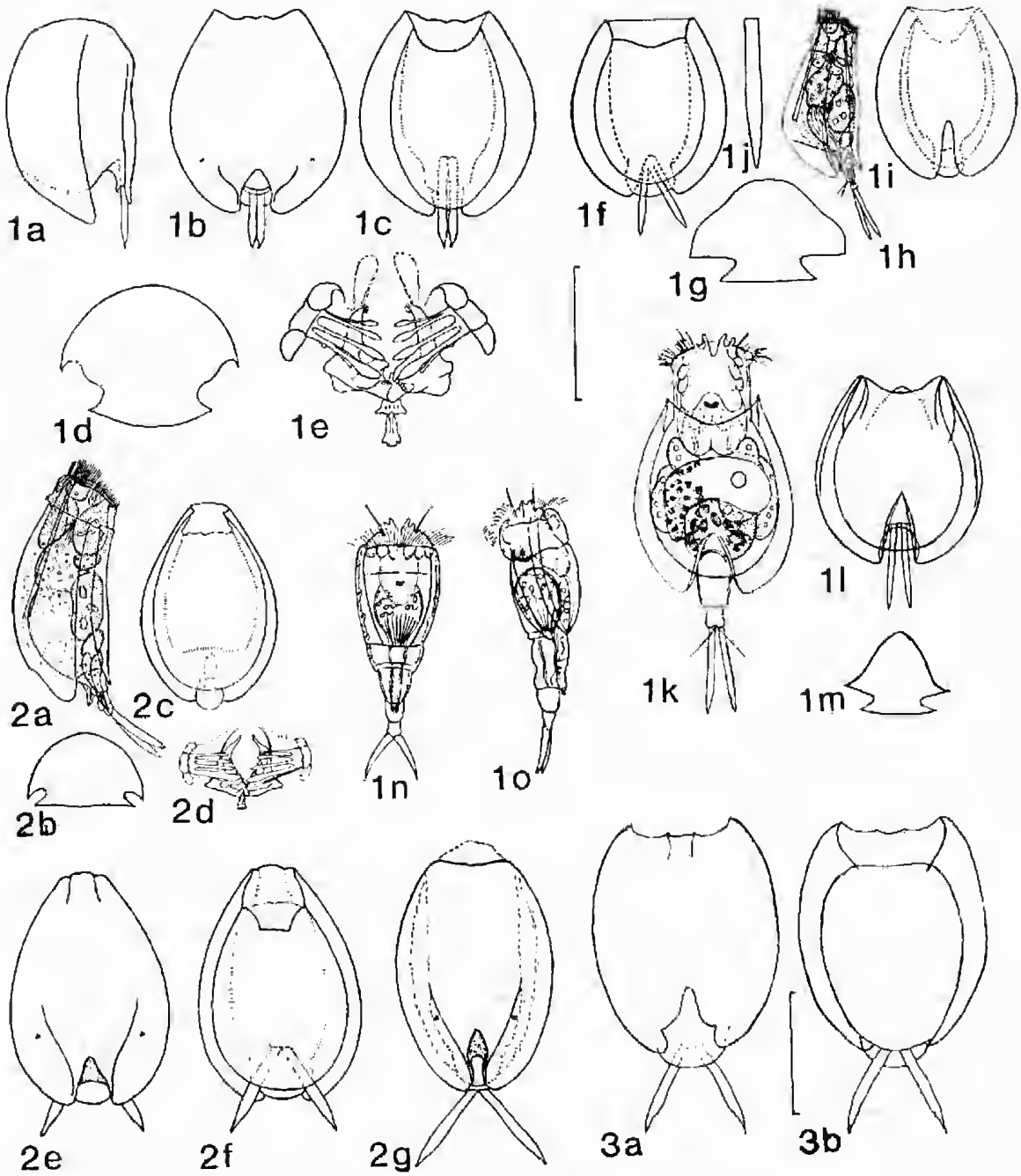


Fig. 7: 1, *Euchlanis meneta* Myers: (a) lateral; (b) dorsal; (c) ventral; (d) lorica cross-section; (e) trophi apical; (f) lorica ventral; (g) cross-section; (h) lateral, swimming; (i) lorica dorsal; (j) toe; (k) dorsal, swimming; (l) dorsal; (m) cross-section; (n) male; (o) male, lateral. 2, *E. proxima* Myers: (a) lateral, swimming; (b) cross-section; (c) ventral; (d) trophi, apical; (e) dorsal; (f) ventral; (g) dorsal. 3, *E. parameneta* Berzins: (a) dorsal; (b) ventral. Fig. 7:1a–e, 2e–g, after Hauer (1935); 1f, g, i, j, after Kutikova (1970); 1k, o, after Wulfert (1960); 3a, b, after Berzins (1973); 2a–d after Myers (1930). Scale lines, top, 100 μm (Fig 7:1, 2), bottom, 50 μm (3a, b).

in plankton samples. Qld (Townsville, Mt Isa).
Literature: Koste 1978; Shiel & Koste 1985.

Mytilina bisulcata (Lucks)
FIG. 10:3

Diplax bisulcata Lucks, 1912 p. 95, Figs. 28a–c.
M. trigona after Harring, 1913 p. 75.

Diagnosis: Lorica with folds on anterior margin; three weak dorsal keels in cross-section; sulcus indistinct; toes shorter than in *M. unguipes* with long tips (cf. *M. unguipes* (Fig. 12:2)).

Length 130–180 μm, toes 60–70 μm, tips 8–14 μm.
Distribution: In peat bogs, areas of decomposition. N.T., Vic.
Literature: Hauer 1936; Koste 1978; Koste & Shiel 1980; Berzins 1982; Tait *et al.* 1984.

Mytilina crassipes (Lucks)
FIG. 10:4

Diplax crassipes Lucks, 1912, p. 96, Fig. 30.
Mytilina crassipes after Carlin-Nilsson, 1934, p. 11.

Diagnosis: Lorica laterally compressed; head with two lateral rounded plates; trophi small, uncus with six teeth; mouth opening with palpar organs; stomach and gastric glands large; two black spots at "forehead" region (?eyes).

Length 220–280 μm (total); lorica 138 μm; toes 57–75 μm; claw 9 μm; trophi 21–30 μm.
Distribution: Cosmopolitan in polysaprobic waters, occasionally in shallow-water plankton. N.T. (Magela Ck).
Literature: Koste 1978, 1981; Koste & Shiel 1980; Tait *et al.* 1984.

Mytilina mucronata (Müller)
FIG. 11:1

Brachionus mucronatus Müller, 1773, p. 134.
Mytilina mucronata after Hofsten, 1909, p. 54.
See Koste (1978) for extensive synonymy.

Diagnosis: Shape of lorica variable, of little taxonomic value (e.g. *M. mucronata* var. *spinigera* (Ehrenberg, 1832)); corona as in *Euchlanis*; lorica granulated anteriorly; dorsally curved spines visible in lateral view beside foot opening; keels end in short hook; foot three-segmented; large cerebral eye present (Fig. 11:1a eye lateral antennae indistinct; dorsal antenna (Fig 11:1a da) visible; trophi of malleate type, unci with five teeth; mastax (Fig. 11:1a mx) with salivary glands; stomach cellular with small gastric glands (Fig. 11:1a gg). Male approximately half female size, also loricate with cerebral eye (cf. (Fig. 3:1, m)).

Length: 170–250 μm, height 96–100 μm, toes 53–60 μm, subitaneous egg 80 μm, male to 135 μm.
Distribution: Cosmopolitan in eutrophic waters, also on the surface of decomposition areas between water plants and in brackish waters. Occasionally in the plankton of shallow ponds and billabongs. Vic. 13.5–22.0°C, pH 7.1–7.4, DO 4.1–10.2 mg l^{-1}, 240 μS cm^{-1}, 5 NTU.
Literature: Evans 1951; Koste 1978.

Mytilina trigona (Gosse)
FIG. 12:1

Diplax trigona Gosse, 1851, p. 201.
Mytilina trigona after Harring, 1913, p. 75.

Diagnosis: Surface of lorica slightly dotted; anterior margin with rounded edge ventrally (cf. *M. acanthophora* Fig. 10:1, 2); cross section almost triangular; narrow double keel; toes with long tips.

Total length: 245–265 μm, lorica length 150–160 μm, toes 68–83 μm.
Distribution: Cosmopolitan in decomposition/inundation areas. Qld.
Literature: Koste 1978; Shiel & Koste 1979; Berzins 1982.

Mytilina unguipes (Lucks)
FIG. 12:2

Diplax unguipes Lucks, 1912 p. 96.
Mytilina bisulcata f. unguipes (Lucks) after Carlin-Nilsson, 1934, p. 11.
Mytilina unguipes (Lucks) after Wiszniewski, 1953, p. 387.

Diagnosis: Anterior margin of lorica without folds, laterally compressed; foot with two joints; toes long, slightly curved with distinct, inflexible claw. Doubtful species, possibly identical with *M. bisulcata*.

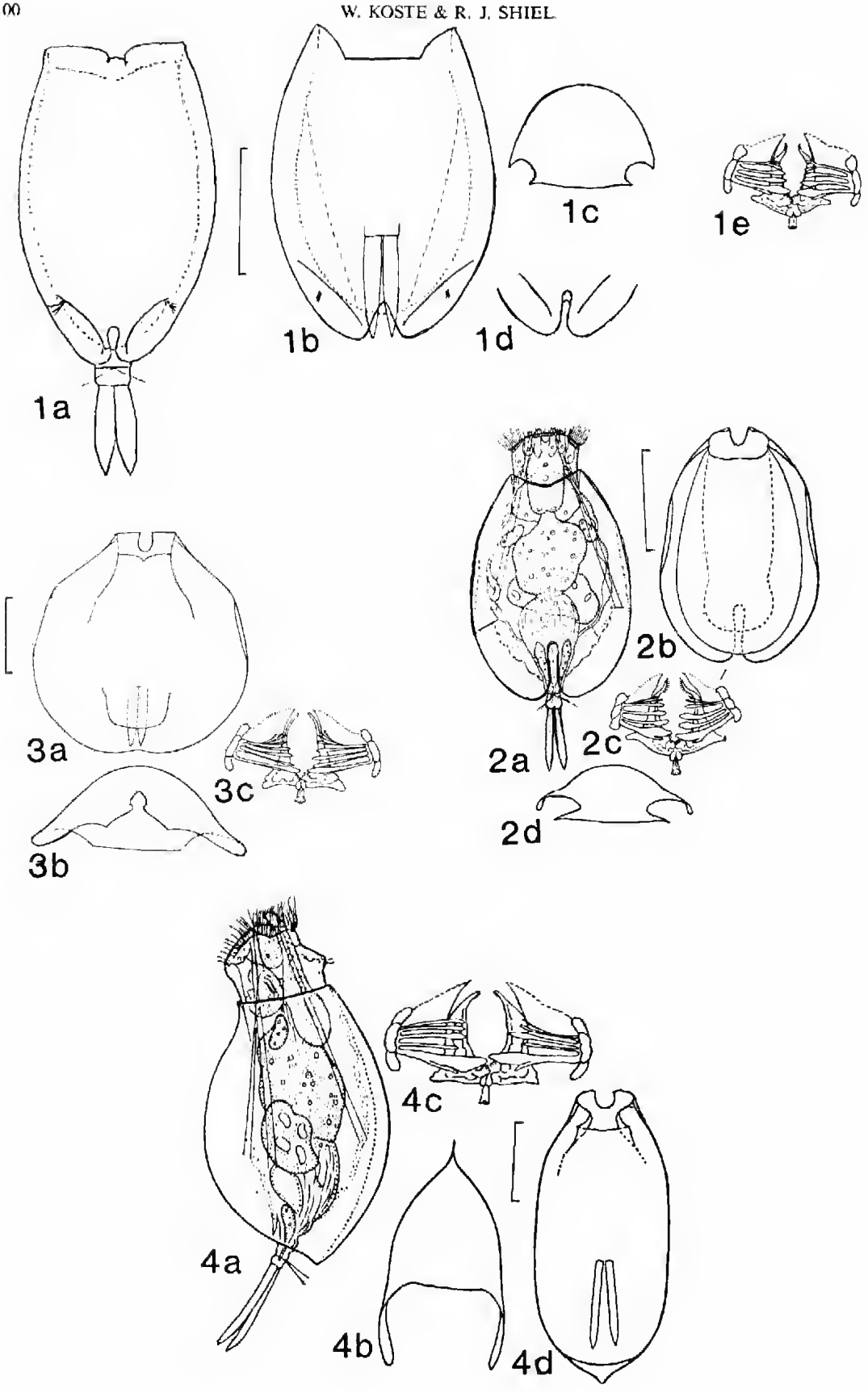
Length 193 μm, height 94 μm, toes 58 μm, claw 13 μm.
Distribution: European peat bog, not yet recorded from Australia.
Literature: Kutikova 1970; Koste 1978

Mytilina ventralis (Ehrenberg)
FIGS 11:3, 4, 5

Salpinia ventralis Ehrenberg, 1832, p. 133, Pl. 4, Fig. 7.
Mytilina ventralis (Ehrenberg) after Harring, 1913, p. 75.

For extensive synonymy see Harring (*loc. cit.*) and Kutikova (1970:519–520).

Diagnosis: Lorica margin granulated; shape and size of lorica and spines very variable; only ventral anterior spines. Short-spined form (var. *brevispina*, 176–215 μm) shown in Fig. 11:3a–c; long-spined form (var. *macracantha*, 250–350 μm) shown in Fig. 11:4. Fig. 11:5 shows rare form described by Wulfert (1965) (*M. ventralis* f. *longidactyla*) with short anterior but long median and shorter caudal ventral hooks. Lorica (90–115 μm) without spines, median caudal spine 62 μm, ventral caudal spines 48 μm, toes 72 μm. These forms may be ecotypes.
Distribution: Cosmopolitan. Probably pancontinental, not yet recorded from S. Aust. (f. typ. from N.S.W., N.T., Qld, Tas., Vic.; *brevispina* from N.T., Qld, Vic.; *macracantha* from N.T., Qld,


1a
1b
1c
1d
1e
2a
2b
2c
2d
3a
3b
3c
4a
4b
4c
4d

W.A. 13.5–28.5°C, pH 5.44–7.9, DO 5.8–10.6 mg l^{-1}, 23–1500 $\mu S\ cm^{-1}$, 6.8–67 NTU, alkalinity 2.7 mg l^{-1}.

Not yet recorded from Australia:
M. hicarinata (Perty, 1850)
M. macrocera (Jennings, 1894)
M. mutica (Perty, 1849)
M. videns (Levander, 1894)
(see Koste 1978 for details).

Genus *Lophocharis* Ehrenberg

Lophocharis Ehrenberg 1838, p. 458.

Strong lorica, surface soft, granulated, but may have honeycomb structure; cross section nearly rhomboid but specimens with flexible integument nearly oval or compressed; dorsum always arched; more or less distinct keel with and without transverse folds; ventral plate with longitudinal and transverse ribs; apical margin with and without serration; ventral aperture rounded, dorsal more triangular; foot-opening ventral; foot with three joints; toes with sharp points; trophi malleate (Fig. 13:1d); cerebral eyes only visible in living animals. Littoral and benthic in habit, seldom found in the plankton. Seven species are known, four have been recorded from Australia.

Key to Species of the Genus *Lophocharis*

1. Lorica >120 μm long with distinct dorsal keel producing triangular cross-section 2
   Lorica <100 μm long, keel indistinct, cross-section more elliptical . . . . . *L. curvata* Berzins
2(1). Anterior margin of lorica strongly serrated, dorsal keel with transverse folds *L. salpina* (Ehrenberg)
   Anterior margin smooth or lightly serrated, dorsal keel without folds 3
3(2). Lorica smooth, dorsal notch of head aperture V-shaped, ventral a broader U-shape; fine striae on both sides of dorsal keel . . . . . *L. naias* Wulfert
   Lorica sculptured as *L. salpina*; head aperture notches V-shaped; no striae beside keel . . . . . *L. oxysternon* (Gosse)

Lophocharis curvata Berzins
FIG. 13:3

Lophocharis curvata Berzins, 1982, p. 12, Fig. 15a–c.
Diagnosis: Small species, lorica elongated U-shape without typical dorsal keel, cross section more dorso-ventrally flattened than in congeners; head aperture margin with dorsal and ventral sinuses, ventral slightly broader; foot aperture broadest posteriorly; toes thin, curved outwards.

Lorica length 95 μm, width 55 μm, toes 18 μm, foot aperture width 32 μm.

Distribution: Endemic, single record from King Parrot Ck, Kinglake, Vic. 18.x.53.
Comment: Although the original description and figures of this rotifer do not meet the requirements of the Code, we feel that the distinctive dorsum, foot aperture and small size warrant retention of specific status until material can be examined.

Lophocharis naias Wulfert
FIG. 13:4

Lophocharis naias Wulfert, 1942, p. 188, Fig. 1a–k.
Diagnosis: Dorsal lorica with shallow keel and lateral longitudinal striations, surface morphology otherwise smooth, unornamented; apical margin of lorica finely serrated; uncus with 7 teeth; inner margin of rami with fine denticles.
Lorica length to 170 μm, width to 105 μm, toes to 21 μm.
Distribution: Europe. Single record, from Coongie Lakes, S. Aust., coll. Jane Roberts, Botany Dept, Univ. of Adelaide, 06.xii.86.
Literature: Koste 1978.

Lophocharis oxysternon (Gosse)
FIG. 13:1

Metopidia oxysternon Gosse, 1851, p. 201.
Lophocharis oxysternon (Gosse) after Harring, 1916, p. 564, Fig. 97:6–13.
Diagnosis: Surface of integument soft or weakly pustulated; ventral plate with deep depression over foot-opening. Many intermediate forms to *L. salpina*, e.g. with slightly serrated apical margin. Trophi (Fig. 13:1d–e) with six uncus teeth.
Lorica length 120–200 μm, toes 24 μm.
Distribution: Cosmopolitan, benthic in fresh and brackish waters, occasionally in plankton. Vic.
Literature: Koste 1978, Berzins 1982.

Lophocharis salpina (Ehrenberg)
FIG. 13:2

Lepadella salpina Ehrenberg, 1834, p. 209.
Metopidia salpina after Hudson & Gosse, 1889, p. 46, Fig. 34:4.
Lophocharis salpina (Ehrenberg) after Harring, 1916, p. 563.
For extensive synonymy see Koste (1978:153)
Diagnosis: Anterior margin always serrated; keel with transverse folds mostly over caudal part of lorica; variable, intermediate forms to *L. oxysternon*; trophi also with six uncus teeth; foot with three joints; toes sharply pointed, ventrally curved.

Length 175–224 μm, lorica 120–135 μm; width

Fig 8: 1, *Euchlanis oropha* Gosse: (a) dorsal; (b) dorsal; (c) cross-section; (d) alternate caudal loricas; (e) trophi, apical. 2, *E. phryne* Myers: (a) dorsal; (b) ventral; (c) trophi, apical; (d) cross-section. 3, *E. pyriformis* Gosse: (a) ventral; (b) lorica cross-section; (c) trophi. 4, *E. collyste* Myers: (a) lateral; (b) cross-section; (c) trophi; (d) ventral. Fig. 8:1a, after Koste (1978); 1–d, after Donner (1964); 1e, 2a–d, 3a–c, 4a–d, after Myers (1930). Scale lines 100 μm (Fig. 8:1–3); 50 μm (4a, b, d).

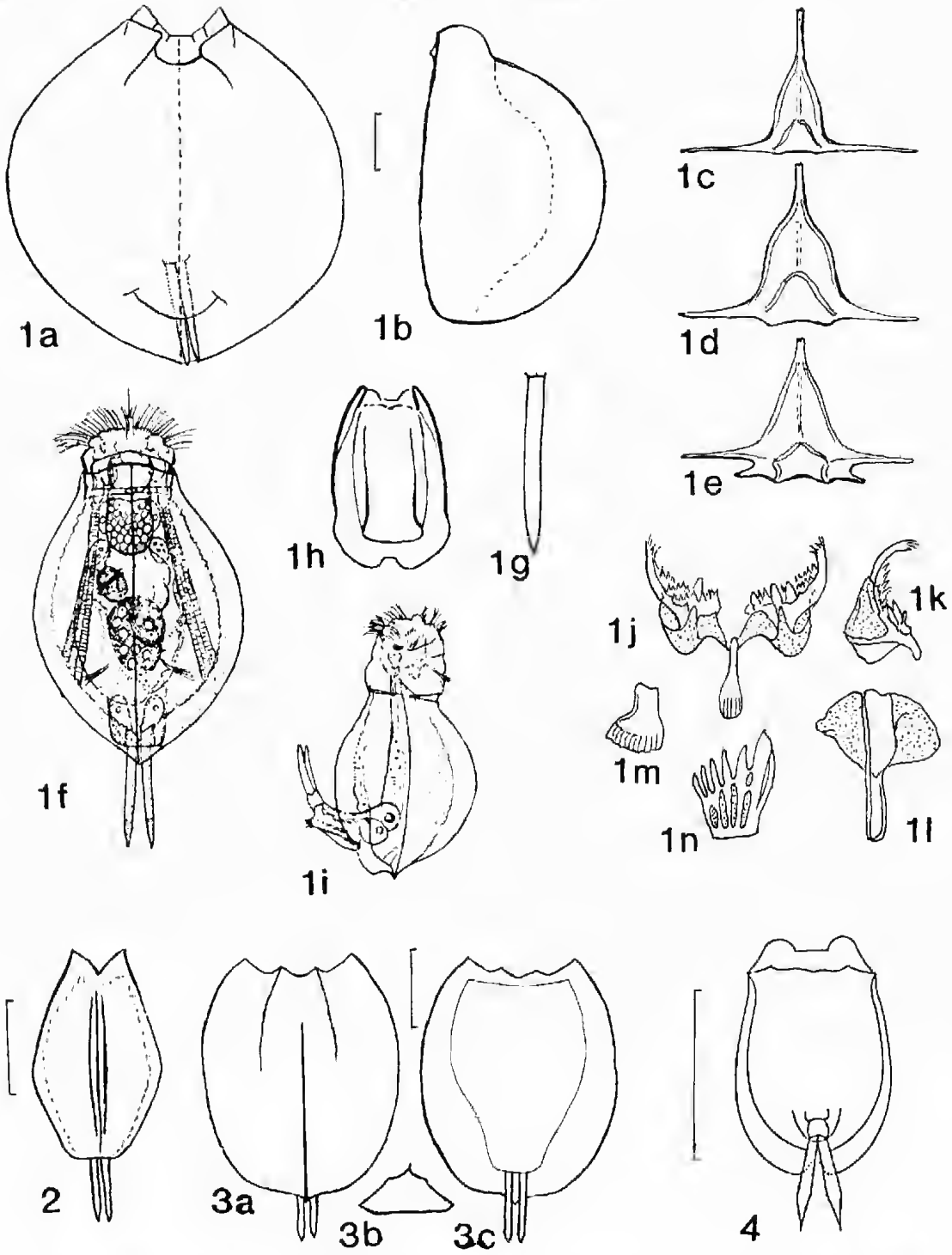


Fig. 9: 1, *Euchlanis triquetra* Ehrenberg, (a) lorica, ventral; (b) lateral; (c–e) different cross-sections; (f) dorsal, swimming; (g) toe; (h) male, contracted; (i) male, lateral, swimming; (j) trophi (fulcrum and rami); (k) ramus; (l) manubrium; (m) fulcrum; (n) uncus. 2, *E. callimorpha* Berzins, dorsal. 3, *E. mamorokaensis* Berzins: (a) dorsal; (b) cross-section; (c) ventral. 4, *E. perpusilla* Ridder, ventral. Fig. 9:1a, after Kutikova (1970); 1b–e, after Grese (1955); 1f–n, after Wulfert (1956); 2, 3a–c, after Berzins (1973); 4, after Ridder (1977). Scale lines 100 μm (adult lorica in each number group).

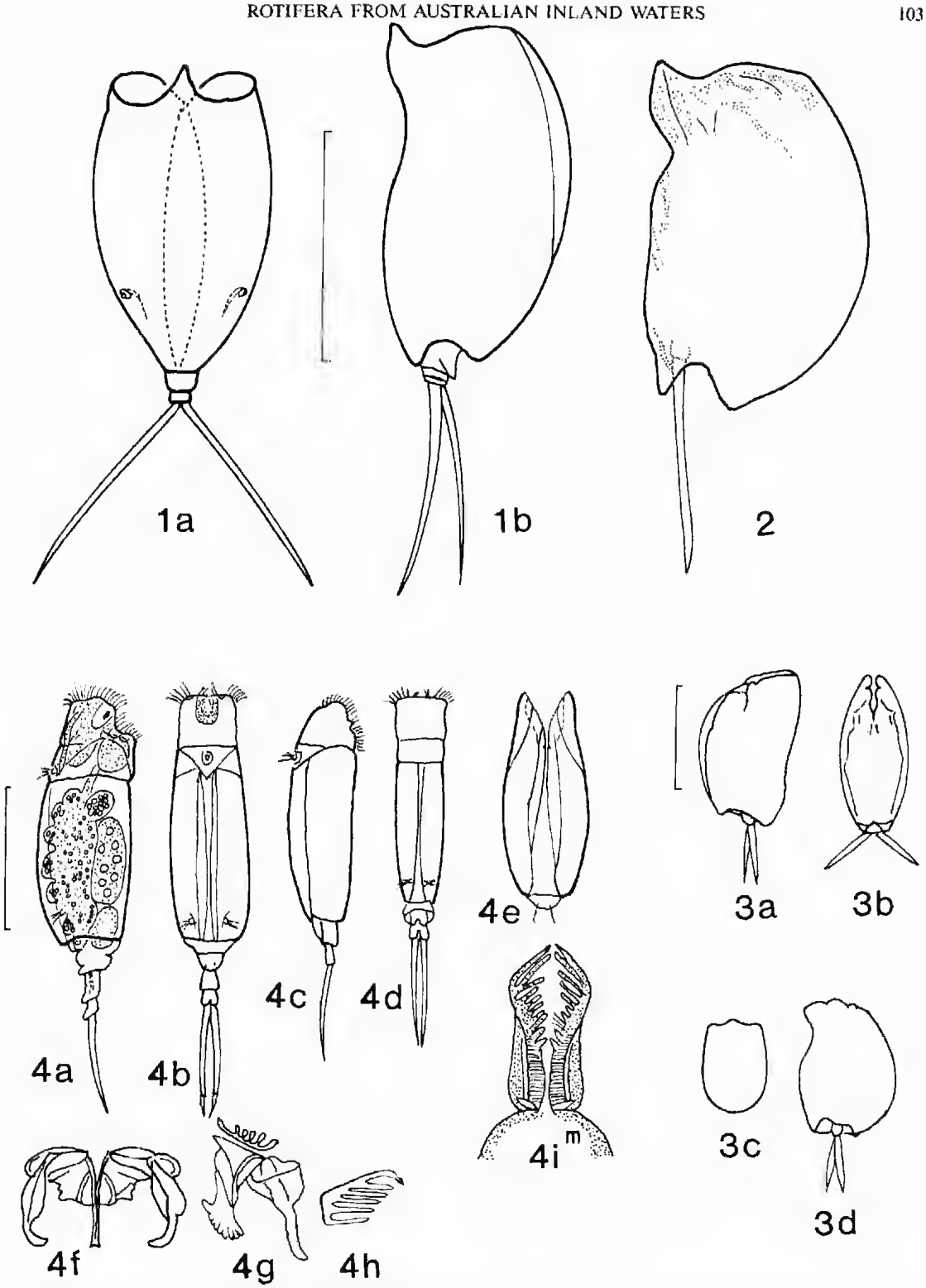


Fig. 10: 1, *Mytilina acanthophora* Hauer from Magela Ck, N.T.: (a) ventral; (b) lateral; (c) cross-section; (d) lateral (cf. 3a, b). 4, *M. crassipes* (Lucks): (a) lateral; (b) dorsal; (c) lateral; (d) dorsal; (e) lorica, contracted; (f) trophi; (g) trophi, lateral; (h) uncus; (i) mouth with palpar organs (m = mouth). Fig. 10:3, after Hauer (1936); 4, after Wulfert (1939). Scale lines 100 μm (adult lorica in each number group).

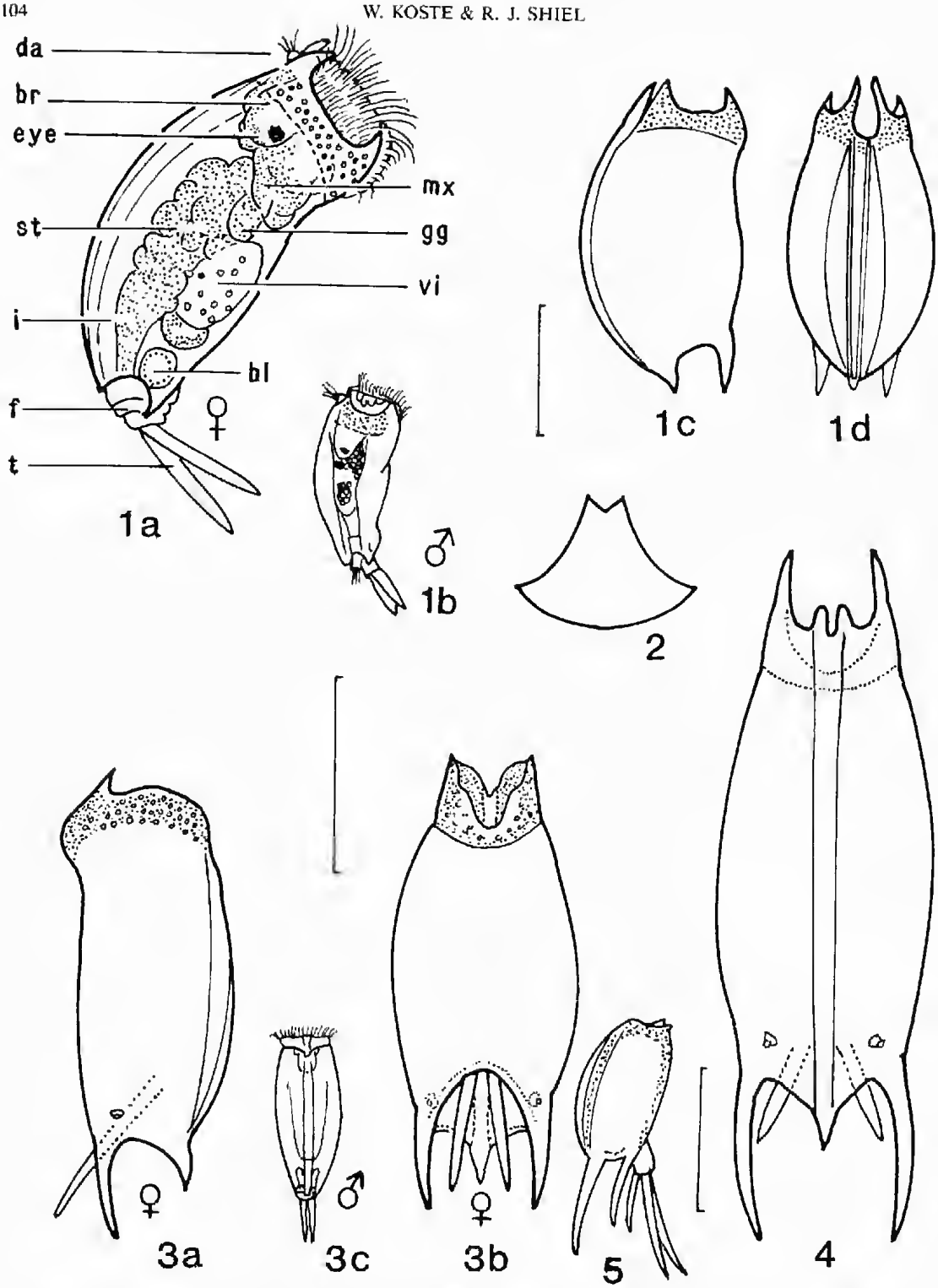


Fig. 11: 1, *Mytilina mucronata* (O. F. Müller): (a) swimming, lateral [*bl* = bladder, *br* = brain, *da* = dorsal antenna, *eye* = cerebral eye, *f* = foot, *gg* = gastric gland, *i* = intestine, *mx* = mastax, *st* = stomach, *t*= toe, *vi* = vitellarium]; (b) male, swimming, lateral; (c) lorica, lateral; (d) lorica, dorsal; 2, *Mytilina* sp. cross-section. 3, *M. ventralis* (Ehrenberg): (a) lorica, lateral; (b) ventral; (c) male, dorsal. 4, *M. ventralis macracantha* (Gosse) lorica, dorsal. 5, *M. ventralis longidactyla* (Wulfert), lateral, from E. Africa. Fig. 11:1a, 2, 3a, b, 4, after Koste (1978); 1b, c, after Pejler (1962); 1d, 3c, after Weber (1898); 5, after Wulfert (1965). Scale lines 100 µm. Top Fig. 11:1b–d; left, 3, 4; bottom, 5.

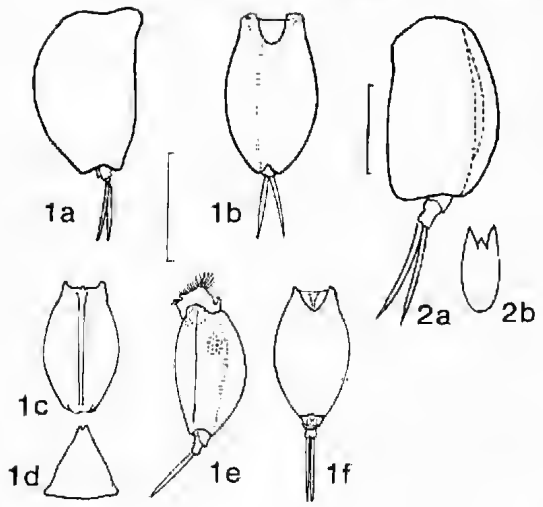


Fig. 12: 1, *Mytilina trigona* (Gosse): (a) lateral; (b) ventral; (c) lorica, dorsal; (d) cross-section; (e) swimming, lateral; (f) ventral. 2. *M. unguipes* (Lucks): (a) lateral; (b) cross-section. Fig. 12:1, after Donner (1954); 2, after Hauer (1936). Scale lines 100 μm.

80–95 μm, toes 25–40 μm.
Distribution: Cosmopolitan, benthic in fresh and brackish waters, also in polysaprobic pools and ponds. Pancontinental. 10.5–30.4°C, pH 5.6–8.4, DO 3.7–11.0 mg l^{-1}, 28–3330 μS cm^{-1}, 5–92 NTU, alkalinity 4.0 mg l^{-1}.
Literature: Evans 1951; Shiel & Koste 1979; Koste 1981; Berzins 1982.

Not yet recorded from Australia:
Lophocharis hutchinsoni Edmondson, 1935
L. naias f. *ambidenta* De Ridder, 1960
L. parva Rudescu, 1960
L. rubens Wulfert, 1939
(see Koste 1978 for details).

Family Trichotriidae Bartos 1959

Three genera with loricate head and body; surface with facets, mostly granulated and with spicules or spines, sec. on dorsum; foot freely movable or with stiff joints; trophi malleate. Generally occur between aquatic macrophytes and in periphyton. In plankton only as migrants.

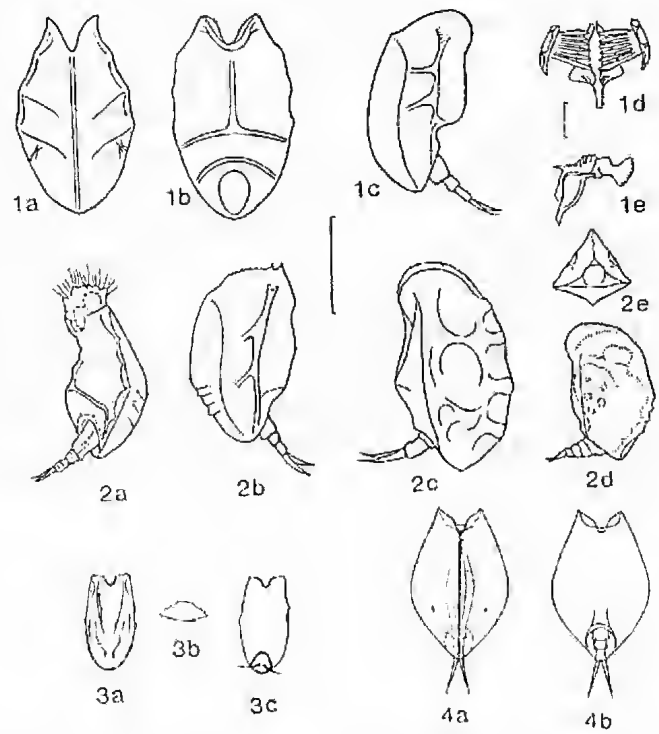


Fig. 13: 1, *Lophocharis oxysternon* (Gosse): (a) dorsal; (b) ventral; (c) lateral; (d) trophi, apical; (e) trophi, lateral. 2, *L. salpina* (Ehrenberg), (a) swimming, lateral; (b) lorica, lateral; (c) lateral; (d) another lorica, lateral; (e) cross-section. 3, *L. curvata* Berzins, (a) lorica, dorsal; (b) cross section; (c) lorica, ventral. 4, *L. naias* Wulfert, (a) lorica, dorsal, (b) lorica ventral. Fig. 13:1 a–e, 2b, after Harring (1916); 2a, after Wulfert (1956); 1d, 2c, after Hauer (1925); 2d, after Klement (1960); 3 after Berzins (1982); Scale lines, centre, 100 μm (1a–c, 2–4); top right, 10 μm (d, e).

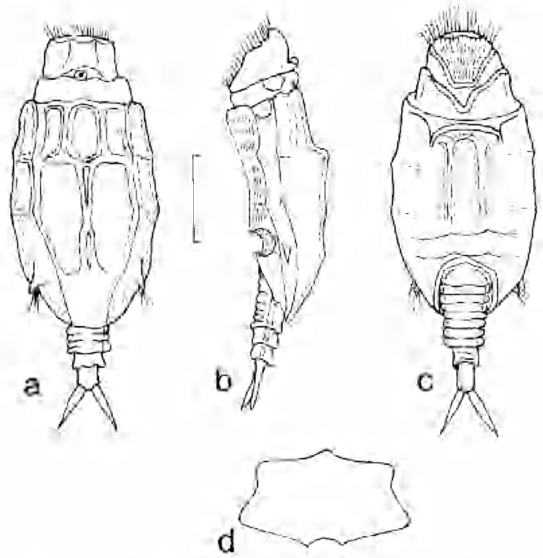


Fig. 14: *Wolga spinifera* (Western): (a) dorsal, swimming; (b) lateral; (c) ventral; (d) cross-section a–c, after Western (1894); d, after Vranovsky (1957). Scale line, 50 μm.

Key to genera of Trichotriidae

1. Lorica with anal segment.....2
   Lorica without anal segment.... *Wolga* Skorikov
2(1). Lorica with distinct elongated spines on dorsum
   .....*Macrochaetus* Perty
   No long spines on lorica
   .....*Trichotria* Bory de St Vincent

Genus *Wolga* Skorikov

Wolga Skorikov, 1903, p. 37.
Monospecific, *Wolga spinifera*.

Wolga spinifera (Western)
FIG. 14

Distyla spinifera Western, 1894, p. 427, Fig. 21:1–4.
Cathypna spinifera after Murray, 1913, p. 545–564.
Lecane spinifera after Harring, 1913, p. 62.
Wolga spinifera (Western) after Skorikov, 1903, p. 37.

Diagnosis: Dorsal lorica divided by ribs into panels or facets; foot not loricate, freely movable; ventral plate with oval foot-opening under transverse distinct line; toes short, slender, pointed. Cross-section of body somewhat compressed (Fig. 14d). Male unknown.

Total length 200–255 μm, lorica 95–145 μm, width 70–90 μm, spicules 5–6 μm.

Distribution: Cosmopolitan in fresh and brackish water, rarely in the pelagic. Two localities, probably more widespread, but rare. N.S.W., Tas. 10.5–13.0°C, pH 6.7–8.4, DO 10.0 mg l^{-1}.

Literature: Koste 1978, Koste & Shiel 1980.

Genus *Trichotria* Bory de St Vincent

Trichotria Bory de St vincent, 1827, p. 752.

Head, body and three foot segments heavily loricate; cross-section hexagonal (Fig. 15:1f) (see comment with *T. buchneri* for exception); most lorica borders with spicules, greater on "shoulders" if head contracted (Fig. 15:3, 4a); lorica with facets, granulated; head lorica composed of several plates; second foot segment with relatively long spines (Fig. 15:1a *fsp*); toes long; corona of *Euchlanis* type; trophi (Fig. 15:1d–e) malleate; red cerebral eye (Fig. 15:1a *eye*). Male loricate (Fig. 15:1b–c). Food algae and detritus, diatoms preferred. *Trichotria* occurs rarely in the plankton (as migrants). Seven species recognized, with many variants; five known from Australia.

Key to Species of the Genus *Trichotria*

1. Cross-section hexagonal, three foot segments..2
   Cross-section triangular, two foot-segments
   ..... *T. buchneri* Koste *et al.*
2(1). Only distal end of terminal foot segment and toes projecting beyond posterior lorica margin; lorica elongated U-shape...*T. pseudocurta* Koste *et al.*
   All three, or at least two, foot segments and toes projecting beyond lorica margin.....3
3(2). Last foot joint with dorsal minute spine between the toe bases.....*T. pocillum* (Müller)
   No minute spine between the toe bases.....2
4(3). Lateral part of dorsal lorica conspicuously large; marginal spicules of lorica directed forward
   .....*T. truncata* Whitelegge
   Lateral lorica not very expanded; spicules if present not directed forward...*T. tetractis* (Ehrenberg)

Trichotria buchneri Koste, Shiel & Tan
FIG. 15:1

Trichotria buchneri Koste, Shiel & Tan, 1988, pp. 120–121, Figs 3–5.

Diagnosis: Lorica of triangular cross section with median keel ending in elongated caudal spine; dorsal lorica with longitudinal rows of denticles to keel (appears granulated by light microscopy); anterior dorsal margin deep U-shaped aperture between two lateral cusps; ventral margin with a shallower U-shaped aperture projects beyond dorsal margin to level of lateral cusps (or slightly beyond tips); rectangular plates cover head, when contracted a pyramidal projection extends to or past anterior lorica margins; foot two-segmented, without spines; toes long, rigid, with acute points.

Length 160–182 μm; width to 125 μm; height to 84 μm; proximal foot segment 24 μm, distal 15 μm; toes 50 μm.

Distribution: Known only from marginal reedbeds of acid dune lakes north of Strahan, on west coast of Tasmania (L. Garcia, L. Ashwood and surrounding dune pools). 17.0–20.0°C, pH 3.1–5.15, 80.6–188.4 μS cm^{-1}, 0.9 NTU.

Comment: The morphological differences between this species and congeners were noted by Koste *et al.* (1988), particularly the domed and keeled cross-section, caudal spine and two-segmented foot. The

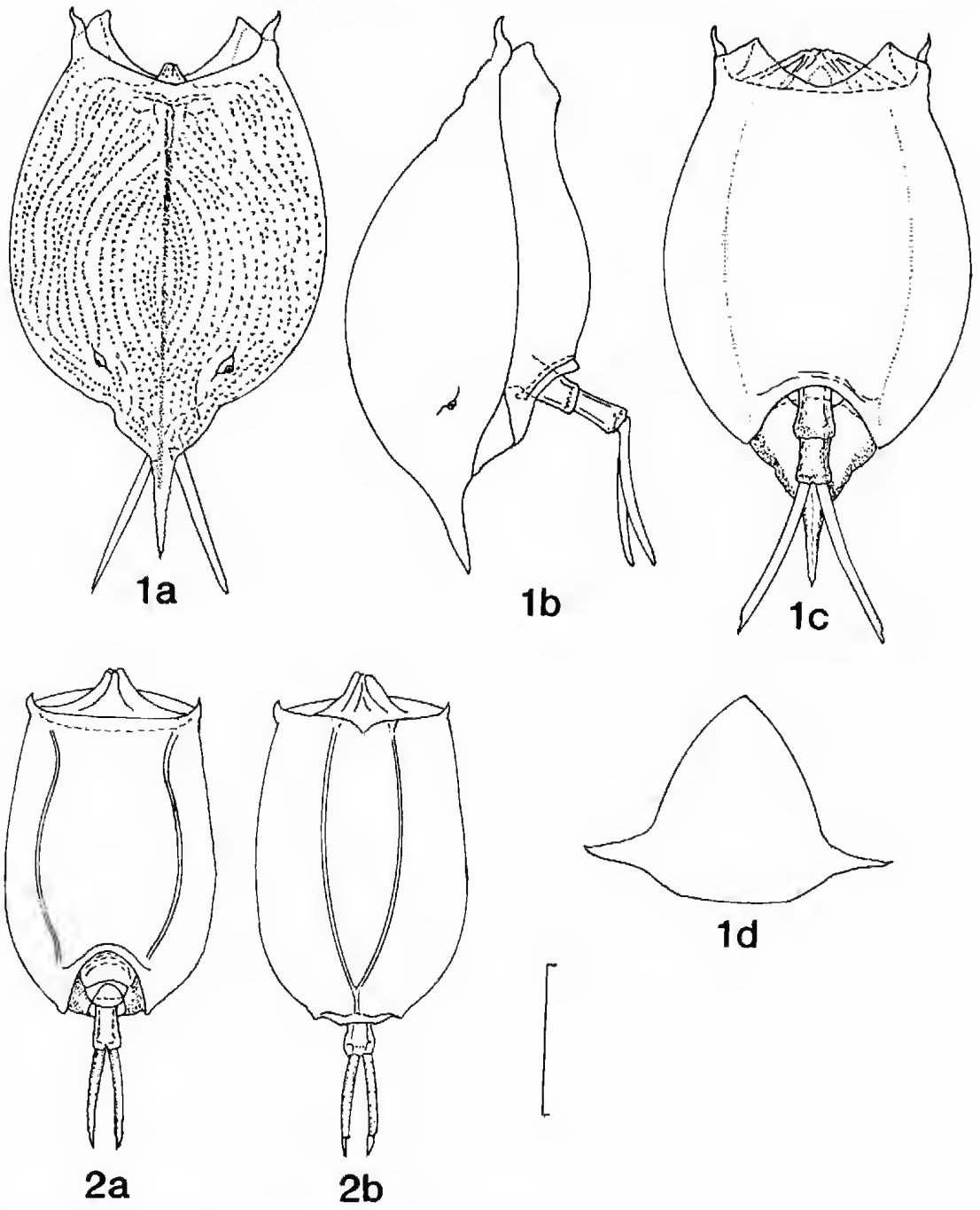
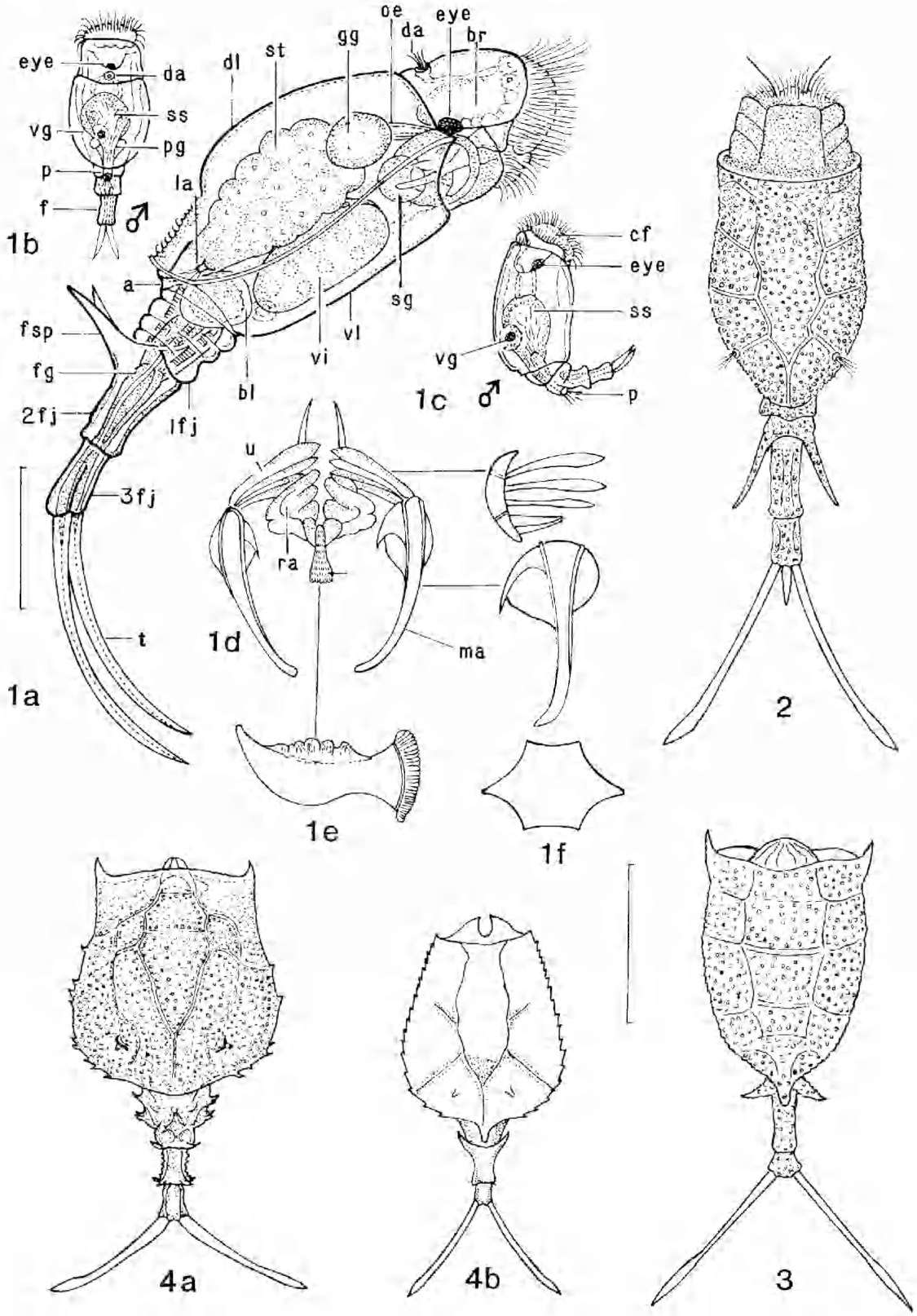


Fig. 15: 1. *Trichotria buchneri* Koste *et al.* a. dorsal, b. lateral, c. ventral; 2. *Trichotria pseudocurta* Koste *et al.* a. dorsal; b. ventral. After Koste *et al.* (1988). Scale line 50 μm.

armoured head is peculiarly trichotriid amongst the Rotifera, but the distinctive features of *T. buchneri* suggest that generic status may be appropriate. Accordingly, additional collections were taken at the type locality in Jan. 1989, and additional sites for the rotifer recorded. A detailed SEM study of this species will appear at a later date (Shiel & Koste, in prep.).


eye
da
ss
vg
pg
p
f
♂
1b
oe
eye
da
br
gg
dl
st
la
a
sg
vl
vi
bl
fsp
fg
2fj
1fj
3fj
t
1a
cf
eye
ss
vg
p
1c ♂
u
ra
ma
1d
1e
1f
2
4a
4b
3

Trichotria pocillum (Müller)
FIG. 16:2

Trichoda pocillum Müller, 1776, p. 281.
Dinocharis pocillum after Ehrenberg, 1830, p. 47.
Trichotria pocillum Bory de St Vincent, 1827, p. 752.
For extensive synonymy see Harring (1913) and Koste (1978).

Diagnosis: Length of foot segments and spine on second foot segment variable; lorica spindle-shaped, surface divided into granulated facets by ridges; corona simple, can be retracted in neck and lateral head plates; male loricate. Rare in plankton.

Length 200–300 μm (total), lorica length 110–140 μm, foot spine 55–66 μm, median minute spine on last foot segment 20–28 μm, toes 83–145 μm.
Distribution: Cosmopolitan in the littoral of fresh and brackish waters. N.S.W., Qld.
Literature: Shiel & Koste 1979.

Trichotria pseudocurta Koste, Shiel & Tan
FIG. 15:2

Trichotria pseudocurta Koste *et al.* 1988, pp. 121–3, Fig. 7.

Diagnosis: Lorica small, U-shaped in outline with both surfaces granulated; triangular cusps at external angles; two raised ribs on ventral surface terminate anterior to raised rim of foot opening; similar ribs form twin keel on dorsal surface, commence either side of median notch on dorsal anterior margin, fuse to a single keel on posterior lorica; foot 3-segmented, without spines; toes with short claws.

Length to 125 μm; width to 74 μm; toes to 30 μm. Distribution: Known only from humic waters of Lake Pedder (White Spur Inlet), Tasmania. 21°C, pH 5.2, 32.6 μS cm^{-1}, 0.5 NTU. Resembles *T. curta* (Skorikow) from the Volga R., however the latter is smaller (110 μm long) with more angular morphology, and lacks the frontal cusps.

Trichotria tetractis (Ehrenberg)
FIG. 16:1, 3

Dinocharis tetractis Ehrenberg, 1830, p. 47.
Trichotria tetractis (Ehrenberg) after Carlin, 1939, p. 40.
For extensive synonymy see Koste (1978:157).

Diagnosis: All morphological characteristics variable; lorica spinulated or not; measurements of lorica, foot segments, dorsal and ventral lorica ornamentation differ between individuals, with morphological series between *T. truncata* and *T. tetractis similis* (latter has very long toes; 120–190 μm (Fig. 17)); caudal part of lorica with one or paired hooks (*T. tetractis caudata*; spinules on second foot segment may be very short (*T. tetractis paupera*).

Length typical form; 218–380 μm, toes to 160 μm; *T. tetractis similis* (Stenroos, 1898): 330–400 μm, second foot segment 42–48 μm, toes 120–190 μm; *T. tetractis caudata:* 230–260 μm, caudal hook of lorica 22–28 μm, toes 50–72 μm.
Distribution: Cosmopolitan in macrophytes, littoral. Commonly in shallow waters of billabongs in N.S.W., Qld, Vic., (typical form) and N.T. (*similis*). 13.5–24.5°C, pH 6.3–8.0, DO 5.8–9.2 mg l^{-1}, 59–400 μS cm^{-1}, 2–160 NTU.
Literature: Koste 1978, 1981, 1984; Shiel & Koste 1979; Green 1981; Berzins 1982.

Trichotria truncata Whitelegge
FIG. 16:4a–b

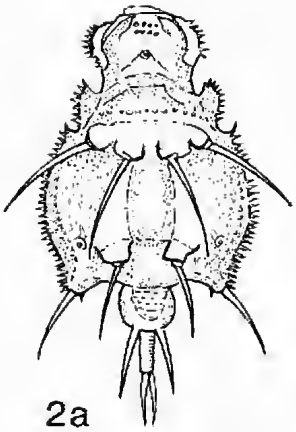
Dinocharis truncatum Whitelegge, 1889, p. 315.
Dinocharis intermedia Bergendal, 1892, p. 107, Fig. 6:33.
Trichotria cornuta Myers, 1938, p. 11.
Trichotria tetractis var. *truncata* (Whitelegge) in Koste, 1978, p. 157.

Diagnosis: Margin of lorica with spicules, also on foot segments, all directed forward; most with shorter toes as in *T. tetractis*, but many intermediate forms; variable facettation on lorica.

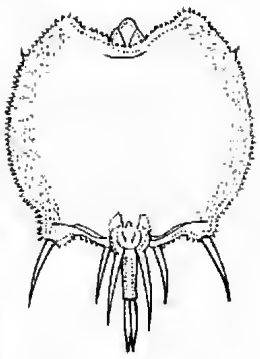
Length 95–146 μm, greatest width 128 μm, toes 60–100 μm.
Distribution: Acidophil, in *Sphagnum*, mainly between plants, seldom in open water. N.S.W., N.T., Vic. 25.0–28.5°C, pH 5.44–7.6, DO 6.0–6.2 mg l^{-1}, 23–145 μS cm^{-1}.
Literature: Koste 1978, 1981, 1984.
Comment: Although morphologically variable, *T. truncatum* is readily distinguished from *T. tetractis* in material we have examined from both Australian and Canadian collections (cf. Chengalath & Koste 1983), and we consider it a distinct species.

Not yet recorded from Australia
T. tetractis caudata (Lucks, 1912); cf. Koste 1984, p. 116;
T. tetractis paupera (Ehrenberg, 1830);
T. curta (Skorikov, 1914);
T. euktosmeta Myers, 1934.
(See Koste, 1978, pp. 157–8 for details).

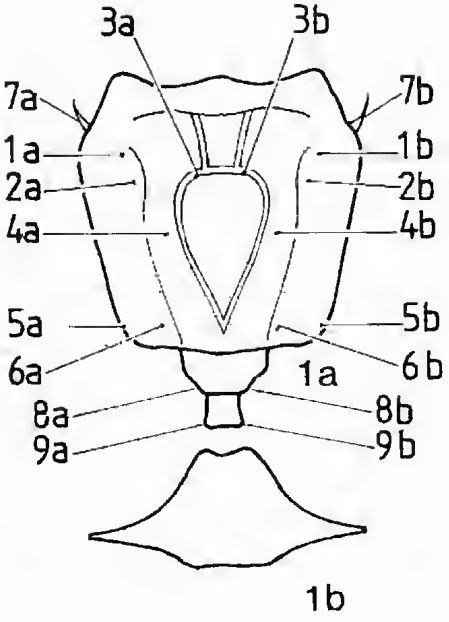
Fig. 16:1, *Trichotria tetractis* (Ehrenberg): (a) female, lateral, swimming; [*a* = anus, *bl* = bladder, *br* = brain, *dl* = dorsal lorica, *da* = dorsal antenna, *eye* = cerebral eye; *fg* = foot gland; *fj* = foot segment; *fsp* = foot spines, *gg* = gastric gland, *la* = lateral antenna, *oe* = oesophagus, *sg* = salivary gland, *st* = stomach, *vi* = vitellarium, *vl* = ventral lorica]; (b) male [*da* = dorsal antenna, *eye* = cerebral eye, *f* = foot, *p* = penis, *pg* = prostate gland, *ss* = testis, *vg* = vestigial gut], (c) male, lateral [*cf* = ciliated fields, corona, *eye* = cerebral eye, *p* = penis, *ss* = testis, *vg* = vestigial gut]; (d) trophi [*ra* = ramus, *u* = uncus, *ma* = manubrium]; (e) uncus, lateral; (f) lorica, cross-section. 2, *T. pocillum* (Müller), female, dorsal, swimming; 3, *T. tetractis*, contracted dorsal. 4, *T. truncata* (Whitelegge): (a) dorsal, from Canada; (b) from Romania [*T. truncata* f. *longispina* after Rodewald 1935]. Fig. 15:1a, 1, 2, 3, 4a) after Koste (1984); 4b, after Rodewald (1935). Scale lines, left 50 μm (Fig. 15:1a–e); lower right, 100 μm (2–4).



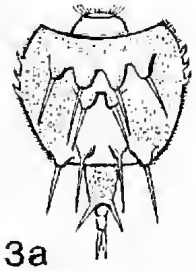
2a



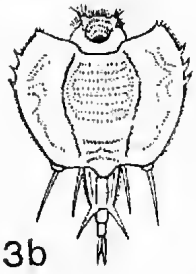
2b



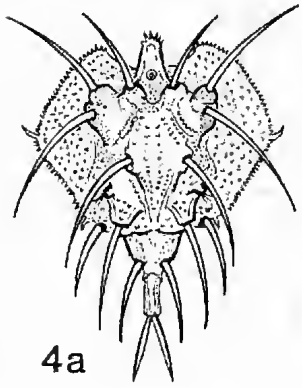
1b



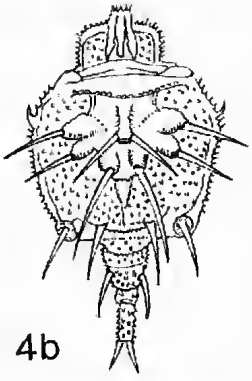
3a



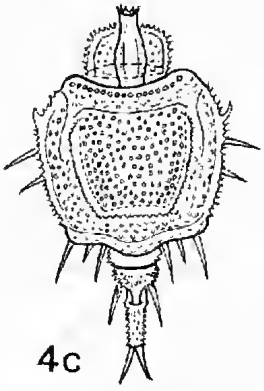
3b



4a

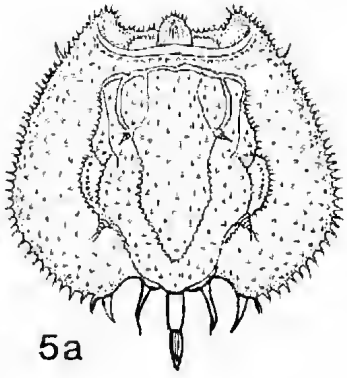


4b

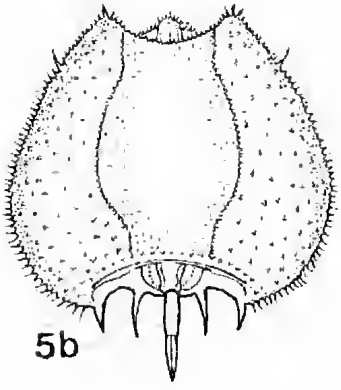


4c

4d



5a



5b

Genus *Macrochaetus* Perty

Lorica flat, hexagonal cross-section, head part retractile; lorica granulated with minute spinules; more or less developed anal section; two loricate foot segments; toes generally spindle-shaped; paired symmetrically inserted spines (Fig. 18:1a); lorica margin with spicules, shoulder hooks larger (Fig. 18:1a, 7a–b); integument opaque; corona simple, with central buccal field and longer lateral sensory hairs (Fig. 18:3b); dorsal and lateral antennae on visible papillae; one cerebral eye; mastax with malleate trophi; eggs and males unknown. All species live between or on water plants and are rare in open water.

Key to Species of the Genus *Macrochaetus*
[refer to FIG. 18:1a]

1. Only one pair of rudimentary anteriosubmedian spines present (2a, b). *M. danneeli* Koste & Shiel
More spines present 2
2(1). Two anterolateral spines, two anteriomedian spines, two posteriomedian spines present, central dorsal spine pair absent (4a, b) .... *M. collinsi* (Gosse)
Central dorsal spine pair present 3
3(2). Two anteriolateral- , two anteriomedian- , two central median- and two anteriosubmedian spines present ..... *M. altamirai* (Arevalo)
Two anteriolateral-, two anteriomedian, two anteriosubmedian- and two posteriomedian spines present ..... *M. subquadratus* (Perty)

Macrochaetus altamirai (Arèvalo)
FIG. 18:3a, b

Polychaetus altamirai Arèvalo, 1918, p. 1–47.
Macrochaetus esthonicus Riikoja, 1925, p. 7, Fig. 2j.
Macrochaetus altamirai (Arèvalo) after Selga, 1952.
M. australiensis Berzins, 1982, p. 18, Figs. 17, 38.

Diagnosis: Shape, size and spicules at lorica margin variable; distinguished from *M. collinsi* only by paired central dorsal spines (see key to species).

Lorica length 80–115 μm, width 76–108 μm, toes 20–28 μm.

Distribution: Cosmopolitan warm stenotherm, rare. Probably more widely distributed in Australia than a single record from Victoria would indicate (as *M. australiensis* by Berzins 1982).

Literature: Koste 1978; Shiel & Koste 1985.

Macrochaetus collinsi (Gosse)
FIG. 18:2

Dinocharis collinsi Gosse, 1867, p. 269, Figs. 1–4.
Macrochaetus collinsi (Gosse) after Harring, 1913, p. 67.
For extensive synonymy see Koste, 1978, p. 161.

Fig. 17: *Trichotria tetractis similis,* lateral (toes 190 μm). After Koste (1984).

Diagnosis: Shape, size, length and number of spinules on margin variable; number of dorsal spines constant; lorica brownish.

Total length 94–250 μm, lorica 53–112 μm, width 62–112 μm, second foot segment 20–25 μm, toes 16–20 μm, dorsal spines 48–66 μm, posteromedian spines 24–48 μm, anal segment spines 32–35 μm.

Distribution: Pantropical and subtropical, warm stenotherm, benthic. N.T., Qld, Tas. 28.5–29.9°C, pH 5.44–5.47, DO 5.45–6.2mg l^{-1}, 23–44 μS cm^{-1}, alkalinity 2.6–2.7 mg l^{-1}.

Literature: Koste 1978; Shiel & Koste 1979; Tait *et al.* 1984.

Macrochaetus danneeli Koste & Shiel
FIG. 18:5

Macrochaetus danneeli Koste & Shiel, 1983, p. 116, Figs. 7a–d.

Diagnosis: Lorica granulated/pustulated; dorsal lorica with terraced sides to blunt keel; margin of keel base with longer spinules; uppermost keel dorsum covered with large cuticular ledges and beading; anal segment spineless; shoulder spines (Fig. 18:1a, 7a), posterolateral- (5a, b),

Fig. 18: 1 (a) points of insertion of spines and setules in *Macrochaetus* Perty spp., dorsal lorica and foot segments [*1a, b* = anteriolateral spines, *2a, b* = anteriosubmedian spines, *3a, b* = anteriomedian spines, *4a, b* = central dorsal spine pair, *5a, b* = posteriolateral spines, *6a, b* = posteriomedian spines, *7a, b* = shoulder hooks, *8a, b* = anal segment spines, *9a,b* = foot segment]; (b) *Macrochaetus* lorica, cross section. 2, *M. collinsi* (Gosse): (a) dorsal, swimming; (b) lorica, ventral. 3, *M. altamirai* (Arevalo): (a) dorsal; (b) ventral. 4, *M. subquadratus* Perty: (a) dorsal; (b) dorsal; (c) ventral; (d) lateral. 5, *M. danneeli* Koste & Shiel: (a) dorsal; (b) ventral. Fig. 18:1a, b, 2a, b, 4a, 5a, b, after Koste & Shiel (1983); 3a, b, after Rodewald (1940); 4a–d, after Wulfert (1964). Scale lines 50 μm each number group.

posteromedian- (6a, b) and only one pair of rudimentary anterosubmedian spines present.

Lorica length 125–130 μm, width 130–137 μm, foot segment 20 μm, toes 16–18 μm.

Distribution: Single locality known: Buffalo Billabong, Magela Creek, N.T. 30.9°C, pH 5.38, DO 4.15 mg l^{-1}, 29 μS cm^{-1}.

Macrochaetus subquadratus Perty
FIG. 18:4a–c

Macrochaetus subquadratus Perty, 1850, p. 22.
Polychaetus subquadratus Perty, 1852, p. 45, Fig. 1:6.

Diagnosis: Lorica generally hexagonal (Fig. 18:4a); ten dorsal spines of variable size and shape; shoulder spines most conspicuously large.

Lorica length 80–135 μm, width 73–140 μm, second foot segment 8–16 μm, toes 15–22 μn.

Distribution: Cosmopolitan in periphyton of aquatic macrophytes. Rare migrant in plankton, more common in billabongs. Thermophile.

Literature: Koste 1978; Shiel & Koste 1979; Green 1981.

Not yet recorded from Australia
M. hauerianus Wulfert 1964 (=*M. collinsi* var. Hauer 1938), p. 534 (Indonesia);
M. longipes Myers 1934, p. 13; see Koste 1978 p. 161;
M. multispinosus Myers 1934, p. 12; recorded from the neotropics and S. Nearctic;
M. philopax Wulfert 1961, p. 87; single find in central Germany;
M. sericus (Thorpe) 1893, p. 182; see Koste 1972, Koste & Shiel 1983 p. 117 Fig. 8.

Acknowledgments

The support of the Australian Biological Resources Study in grants to RJS, the use of the facilities of the Botany Department, University of Adelaide in manuscript preparation and long-term loan of microscope facilities to WK by the Deutschen Forschungsgemeinschaft are gratefully acknowledged. The Department of Lands, Parks and Wildlife, Hobart, supported fieldwork in the World Heritage Area in Jan. 1989. Particular thanks to the staff of the Peter Till Laboratory, Albury-Wodonga Development Corporation (now Murray-Darling Freshwater Research Centre) for providing collections from billabongs in their study area, to Professor D. G. Frey, Biology Department, Indiana University for the donation of an extensive series of rotifer publications from his Limnology Library, and to an anonymous referee for critical comments on an earlier draft. Our thanks also to Charles Hussey (BM(NH)) for checking obscure references, Anne Grant, CSIRO Publications Service, for editorial expertise, and Lor Wai Tan for final corrections.

References

AHLSTROM, E. H. (1934) Rotatoria of Florida. *Trans. Amer. Microsc. Soc.* **53**, 251–6.
ARÉVALO, C. (1918) Algunos Rotiferos planktonicos de la Albufera de Valencia. *Ann. Inst. Gen. Tech. Valencia* **8**, 1–47.
BARTOS, E. (1959) Virnici. Rotatoria. *Fauna CSR* **15**, 1–969.
BARTSCH, S. (1877) Rotatoria Hungariae. *Kir. Mag. Termész. Tarsulat Megbizásából, Budapest*, 1–52.
BEAUCHAMP, P. de (1910) *Dipleuchlanis* nov. subgen. pour *Euchlanis propatula* Gosse. *Bull. Soc. Zool. Fr.* **35**, 122.
_____ (1965) Classe des Rotiferés. *Traité Zool.* **4**, 1225–1379.
BERGENDAL, D. (1982) Beiträge zur Fauna Grönlands. 1. Zur Rotatorienfauna Grönlands. *Acta univ. Lund.* **28**, 1–180.
BERZINS, B. (1957) Beitrag zur Rotatorienfauna. Gambiens. *Acta tropica* **14**, 230–235.
_____ (1963) Two new *Keratella*, Rotatoria, from Australia. *Hydrobiologia* **22**, 380–383.
_____ (1973) Zwei neue *Euchlanis* arten, Rotatoria. *Zool. Anz.* **190**, 125–127.
_____ (1982) Contribution to the knowledge of Rotatoria of Australia. (University of Lund Publication, Lund).
BORY DE ST VINCENT, J. -B. G. M. M. (1826) Essai d'une classification des animaux microscopiques. (Paris).
_____ (1827) Encyclopédie méthodique. Pt. II.
CARLIN, B. (1939) Über die Rotatorien fauna einiger Seen bei Aneboda. *Medd. Limnol. Inst. Lunds Univ.* 2, 1–68.
CARLIN-NILSSON, B. (1934) Über einige für Schweden neue Rotatorien. *Ark. Zool.* **26A**, 1–14.
CHENGALATH, R. & KOSTE, W. (1983) Rotifera from northeastern Quebec, Newfoundland and Labrador, Canada. *Hydrobiologia* **104**, 49–56.
DADAY, E. (1897) Új-Guineai Rotatoriak. *Math. Termész. Értesito* **15**, 131–48.
DONNER, J. (1954) Zur Rotatorienfauna Südmährens. (Österr. Zool. Zeits) **5**, 30–117.
_____ (1964) Die Rotatorien-synusien submerser Makrophyten der Donau bei Wein und mehrerer Alpenbache. *Arch. Hydrobiol. Suppl.* **27**, 227–234.
EDMONDSON, W. T. (1935) Some Rotatoria from Arizona. *Trans. Amer. Microsc. Soc.* **54**, 301–336.
EHRENBERG, C. G. (1830) Organisation, Sytematik und geographisches Verhältniss der Infusionstierchen. *Abh. Akad. Wiss. Berl.* (for 1828–30), pp. 1–108.
_____ (1832) Über die Entwicklung und Lebensdauer der Infusionstiere, nebst ferneren Beiträgen zu einer Vergleichung ihrer organischen Systeme. *Ibid* (for 1831), pp. 1–154.
_____ (1834). Beitrag zur Erkenntniss grosser Organisation in der Richtung des kleinsten Raumes. 3. *Ibid.* (for 1833), pp. 145–336.
_____ (1838) Die Infusionstierchen als volkommene Organismen. Ein Blick in das tiefere organische Leben der Natur. Folio. (Leipzig).
EVANS, J. (1951) The rotifer record of Victoria. *Proc. Microsc. Soc. Vict.* **11**, 4–7.
EVENS, F. (1947) Quelques rotateurs nouveaux observès *en Congo Belge. Rev. Zool. Bot. Afric.* **40**, 175–184.
EVENS, F. (1947) Quelques rotateurs nouveaux observès en Congo Belge. *Rev. Zool. Bot. Afric.* **40**, 175–184.

FADEEW, N. (1924) Notes sur les Rotifères de la Russie. Les representants du genre *Diplewchlanis* de la fauna russe. *Ann. sci. nat.* ser. 10, **7**, 179–195.
GALLAGHER, J. J. (1957) Generic classification of the Rotifera. *Proc. Penn. Acad. Sci.* **31**, 182–187.
GOSSE P. H. (1851) A catalogue of Rotifera found in Britain, with descriptions of five new genera and thirty two new species. *Ann. Mag. Nat. Hist.* Ser 2, **8**, 197–203.
——— (1867) *Dinocharis collinsii* a Rotiferon new to science. *Intellect. Obs. London* **10**, 269–272.
——— (1887) Twenty-four new species of Rotifera. *J. R. Micros. Soc.* Ser. 2 **7**, 1–7.
GREEN J. (1981) Associations of rotifers in Australian crater lakes. *J. Zool. Lond.* **193**, 469–486.
GRESE, B. S. (1955) [On the rotifer fauna of Siberia]. *Zametki Faun. Flor. Siberia, Tomsk* **18**, 53–62. [Russian].
HARRING, H. K. (1913) Synopsis of the Rotatoria. *Bull. Am. Mus. Nat. Hist.* **81**, 1–226.
——— (1916) A revision of the rotatorian genera *Lepadella* and *Lophocharis* with descriptions of five new species. *Proc. U.S. Nat. Mus.* **51**, 527–567.
——— (1921) Rotatoria. *Repl. Canad. Arctic Exped. 1913–1918*, Ottawa. **8**, E1–23.
HAUER, J. (1925) Rotatorien aus den Salzgewässern von Oldesloe (Holstein). *Mitt. Geogr. Ges. Nat. Hist. Mus. Lubeck* II **30**, 152–195.
——— (1930) Zur Rotatorienfauna Deutschlands (I). *Zool. Anz.* **92**, 219–222.
——— (1935) Zur Rotatorienfauna Deutschlands (IV). *Zool. Anz.* **110**, 260–264.
——— (1936) Rädertier aus dem Naturschutzgebiet Weingartener Moor. *Beitr. naturkdl. Forsch. Südwestdeutschl., Karlsruhe* **1**, 129–152.
——— (1938) Die Rotatorien von Sumatra, Java und Bali nach der Ergebnissen der Deutschen Limnologischen Sunday-Expedition. *Arch. Hydrobiol. Suppl.* **15**, 296–384.
——— (1965) Zur Rotatorienfauna des Amazonasgebietes. *Int. Rev. ges. Hydrobiol.* **50**, 341–89.
HOFSTEN, N. VON (1909) Rotatorien aus dem Mästermyr (Gottland) und einigen andern schwedischen Binnengewässern. *Ark. Zool.* **6**, 1–125.
HUDSON, C. T. & GOSSE, P. H. (1886) 'The Rotifera or wheel-animalcules, both British and foreign'. 2 vols. (Longmans, London).
——— (1889) 'The Rotifera or wheel-animalcules, both British and foreign'. Suppl. (Longmans, London).
IROSO, I. (1910) Primo contributo alla conoscenza dei Rotiferi del lago-stagno craterico di Astroni. *Mon. Zool. Ital.* **21**, 299–304.
ISSEL R. (1901) Studi sulla termale euganea. (Nota preventiva). *Boll. Mus. Zool. Univ. Genova* **108**, 5 pp.
——— (1906) Sulla termobiosi negli animali aquatici. Ricerche faunistiche *e biologiche. Att. Soc. Ligustica Sci. Nat. Genova* **17**, 3–72.
JENNINGS, H.S. (1894) A list of the Rotatoria of the Great Lakes and some of the inland lakes of Michigan. *Bull. Mich. Fish. Comm.* **3**, 1–31.
KLEMENT, V. (1960) Zur Rotatorienfauna ephemerer Gewässer. *Jh. Ver. vaterl. Naturkde. Württemberg* **115**, 338–349.
KOCH-ALTHAUS, B. (1962) Weitere neue und bemerkenswerte Rotatorien aus dem Stechlinsee. *Limnologica Berl.* **1**, *65–85.*
KOSTE, W. (1972) Rotatorien aus Gewässern Amazoniens. *Amazoniana* **3**, 258–505.
——— (1974) Rotatorien aus einem Ufersee des unteren Rio Tapajos dem Lago Parani (Amazonien). *Gewass. Abwass.* **53**, 43–68.
——— (1978) Rotatoria. Die Rädertiere Mitteleuropas. Bestimmungswerk begründet von Max Voigt. 2 Vols. (Borntraeger, Stuttgart.)
——— (1979) New Rotifera from the River Murray, southeastern Australia, with a review of the Australian species of *Brachionus* and Keratella. *Aust. J. Mar. Freshwat. Res.* **30**, 237–253.
——— (1981) Zur Morphologie, Systematik und Ökologie von neuen monogononten Rädertieren (Rotatoria) aus dem überschwemmungsgebiet des Magela Ck in der Alligator River Region, Australiens N.T.I. *Osnabrucker Naturwiss. Mitt.* **8**, 97–126.
——— (1984) Das Rädertier Porträt. *Trichotria tetractis* und verwandte Arten. *Mikrokosmos* **73**, 113–118.
——— & ROBERTSON, B. (1983) Taxonomic studies of the Rotifera (Phylum Aschelminthes) from a Central Amazonian varzea lake, Lago Camaleao (Ilha de Marchantaria, Rio Solimoes, Amazonas, Brazil) *Amazoniana* **7**, 225–254.
——— & SHIEL, R. J. (1980) New Rotifera from Australia. *Trans. R. Soc. S. Aust.* **104**, 133–144.
——— (1983) Morphology and ecology of new monogonont Rotifera from the Alligator Rivers region, Northern Territory. *Ibid.* **107**, 109–121.
——— (1986a) New Rotifera (Aschelminthes) from Tasmania. *Ibid.* **110**, 93–109.
——— (1986b) Rotifera from Australian inland waters. I. Bdelloidea (Rotifera: Digononta). *Aust. J. Mar. Freshwater Res.* **37**, 765–792.
——— (1987a) Tasmanian Rotifera: affinities with the Australian fauna. *Hydrobiologia* **147**, 31–43.
——— (1987b) Rotifera from Australian inland waters. II. Epiphanidae and *Brachionidae* (Rotifera: Monogononta). *Invert. Taxon.* **1**, 949–1021.
——— & TAN L. W. (1988) New rotifers (Rotifera) from Tasmania. *Trans. R. Soc. S. Aust.* **112**, 119–131.
KUZAR, L. (1914) Zur Rotatorienfauna der Torfmoorgewässer, zugl. f. Ergänzung dieser fauna Galiziens. *Zool. Anz.* **44**, 423–425.
KUTIKOVA, L. A. (1959) [A study of the rotifer fauna of Latvia.] *Fauna Latv. S.S.R.* **2**, 211–231. [Russian].
——— (1970) [Rotifer fauna of the USSR. Subclass Eurotatoria]. *Fauna CCCP* **104**, 1–744. (Akad. Nauk CCCP, Leningrad.) [Russian]
——— & VASSILEVA, G. L. (1982) [New and endemic rotifers of the genera *Synchaeta* and *Euchlanis* in the fauna of Baikal.] pp. 43–58 *In* G. I. Galazii (Ed.) Novoe o faune Baikala 3. "Nauka" Novosibirsk. [Russian]
LAUTERBORN, R. (1913) Rotatoria. *Handwörterbuch d. Naturwiss.* **8**, 483–495.
LEISSLING, R. (1924) Das Männchen *von Euchlanis deflexa. Zool. Anz.* **59**, 48–51.
LEVANDER, K. M. (1894) Materialen zur kenntnis der Wasserfauna in der Umgebung von Helsingfors, mit besonderer Berücksichtigung der Meeresfauna. II. Rotatoria. *Acta Soc. Fauna. Flora Fennica* **12**, 1–70.
LUCKS, R. (1912) 'Zur Rotatorienfauna Westpreussens'. (Danzig).
MANFREDI, P. (1927) Prima nota intorno alla fauna della Gora di Bertonica (Adda). Rotiferi. *Boll. pesca, piscicolt, e idrobiol., suppl. mem.* **1**, Ser. B., 3–58.
MULLER, O. F. (1773) 'Vermium terrestrium et fluviatilium, seu animalium infusiorum, helminthicorum et testaceorum, non marinorum, succincta Historia.' Vol. 1. Infusoria. (Copenhagen and Leipzig).
——— (1776) 'Zoologiae Danicae prodromus, seu animalium Daniae et Norvegiae indigenarum characteres homina et synonyma imprimis popularium.' (Copenhagen.)

MURRAY, J. (1913) Notes on the family Cathypnidae. *Jl R. Micros. Soc.* Ser. 2. **33**, 545–564.

MYERS, F. J. (1930) The rotifer fauna of Wisconsin. V. The genera *Euchlanis* and *Monommata*. *Trans. Wis. Acad. Arts Sci. Lett.* **25**, 353–413.

_____ (1934) The distribution of Rotifera on Mount Desert Island. VII. New Testudinellidae of the genus *Testudinella* and a new species of Brachionidae of the genus *Trichotria*. *Amer. Mus. Nov.* **761**, 1–8.

_____ (1936) Psammolittoral rotifers of Lenape and Union Lakes, New Jersey. *Ibid.* **830**, 1–27.

_____ (1938) New species of Rotifera from the collection of the American Museum of Natural History. *Ibid.* **1101**, 1–17.

PARISE, A. (1963) Observazione sull'eterogonia sperimentale in *Euchlanis*. *Atti Accad. Naz. Lincei. Rend. Cl. Sci.* Ser. 8 **35**, 609–615.

_____ (1966) The genus *Euchlanis* (Rotatoria) in the marsh of Fucecchio (Central Italy) with description of a new species. *Hydrobiologia* **27**, 328–336.

PEJLER, B. (1962) On the taxonomy and ecology of benthic and periphytic Rotatoria. *Zool. Bidrag. Upps.* **33**, 327–422.

PERTY, M. (1849) Mikroskopische Organismen der Alpen und der italienischen Schweiz. *Mitt. Naturf. Ges. Bern* **164/165**, 153–176.

(1850) Neue Rädertiere der Schweiz. *Ibid.* **169/170**, 17–22.

_____ (1852) System der Infusorien. *Ibid.* **231/232**, 57–68.

REMANE, A. (1929–1933) Rotatoria. In "Klassen u. Ordnungen des Tierreichs". (Ed. H. G. Bronn.) Vol. 4. pp. 1–576. (Leipzig.)

RIDDER, M. DE (1960) Ecologisch-faunistische studie van der raderdiertjes van de Camargue. *Verh. Konninkl. vlaamse akad. wetenschap. let. Belg.* **65**, 5–201.

_____ (1972) Rotatoria. *The Zoology of Iceland II* **13**, 1–105.

_____ (1977) Rotatoria of the Caribbean Region. *Studies on the fauna of Curacao and other Caribbean islands* **52**, 73–134.

_____ (1981) Rotifera. *Hydrobiological survey of the Lake Bangweulu Luapula River basin* **11**, 191 pp.

RIIKOJA, H. (1925) (Index of rotifers in the bay of Matsalu and its immediate environment, with description of a new species, *Macrochaetus esthonicus*.) *Trans. Nat. Soc. Univ. Tartu* **32**, 1–12. [Estonian]

RODEWALD, I. (1935) Die Raderrierfauna der Bukowina. Ihre Systematik Biologie ung geographische Verbreitung. *Bull. Fac. Stiinte Cernauti* **8** (1934), 187–266.

_____ (1940) Rädertierfauna Rumaniens IV. *Zool. Anz.* **130**, 272–289.

RODEWALD RUDESCU, L. (1960) Radertierfauna Rumäniens VI. *Ibid.* **164**, 450–68.

RUDESCU, L. (1960) Rotatoria. *Fauna Rep. Pop. Rom.* **2**, 1–1092.

RUTTNER-KOLISKO, A. (1972) III. Rotatoria. *Das Zooplankton der Binnengewasser. Die Binnengewasser* **26**, 99–234.

_____ (1974) Plankton Rotifers, Biology and Taxonomy. *Ibid*, Suppl. **1**, 1–146.

SEGA, D. (1952) Contribution al conocimiento de los Rotiferos de España. I. Rotiferos de las aguas continentales Españoles y su distribución. *Publ. Inst. Biol. Aplic.* Barcelona **11**.

SHIEL, R. J. (1976) Associations of Entomostraca with weedbed habitats in a billabong of the Goulburn River, Victoria. *Aust. J. Mar. Freshwat. Res.* **27**, 533–549.

_____ & KOSTE, W. (1979) Rotifera recorded from Australia. *Trans. R. Soc. S Aust.* **103**, 57–68.

_____ (1985) New species and new records of Rotifera (Aschelminthes) from Australian waters. *Ibid.* **109**, 1–15.

SHIEL, R. J., WALKER, K. F. & WILLIAMS, W. D. (1982) Plankton of the lower River Murray, South Australia. *Aust. J. Mar. Freshwater Res.* **33**, 301–327.

SKORIKOV, A. (1903) [Note on three new species of Rotatoria.] *Ann. Mus. Zool. Acad. Sci., St Petersburg* **8**, 19–21. [Russian].

_____ (1914) [On the plankton of the lower Volga, with a contribution to the question of "Potamoplankton".] *Tr. ichtyol. Lab. Astrachan* **3**, 3–33. [Russian].

TAIT, R. D., SHIEL, R. J. & KOSTE, W. (1984) Structure and dynamics of zooplankton communities, Alligator Rivers region, N.T., Australia. *Hydrobiologia* **113**, 1–13.

THORPE, V. C. (1887) On certain Rotifera found in the ponds of the gardens of the Acclimatisation Society, Brisbane. *Proc. R. Soc. Qld* **4**, 28–30.

_____ (1893) The Rotifera of China. *J. Roy. Microsc. Soc.*, **12**, 145–152.

VOIGT, M. (1957) "Rotatoria. Die Rädertiere Mitteleuropas". 2 Vols. (Borntraeger, Stuttgart.)

VORONKOV, N.V. (1912) [On the plankton of the lakes of the Yamal Peninsula. Rotifers and general character of the plankton.] *Ann. Mus. Acad. Sci., St Petersburg* **16**, 180–214. [Russian].

VRANOVSKY, M. (1957) Neikdko virnikov (Rotatoria) z ryzovych poli na Slovensku. *Biologia* Bratislava **12**, 661–671.

WANG CHIA-CHU (1961) ["Freshwater Rotifera of China"]. Inst. Freshwater Hydrobiol., Peking. 288 pp. [Chinese].

WEBER, F. (1898) Faune rotatorienne du bassin de Leman. *Rev. Suisse. zool.* **5**, 263–785.

WESENBERG-LUND, C. (1929) Rotatoria. *Handbuch d. Zool.* **2**, 1–120.

WESTERN, G. (1894) On *Distyla spinifera*. *J. Queckett Micr. Cl.* Ser. 2 **5**, 427–428.

WHITELEGGE, T. (1889) List of the marine and freshwater invertebrate fauna of Port Jackson and the neighbourhood. *Proc. R. Soc. N.S.W.* **23**, 163–323.

WIERZEJSKI, A. (1893) Rotatoria (wrotki) Galicyi. *Bull. Internat. Acad. Sci. Cracovie* (1892), 402–407.

WISZNIEWSKI, J. (1953) Fauna wrotków Polski i przyleglych. *Pol. Arch. Hydrobiol.* **1**, 317–490.

WULFERT, K. (1939) Beiträge zur Kenntnis der Rädertierfauna Deutschlands. IV. Die Rädertiere der Saale-Elster Niederung bei Merseburg in ökologisch-faunistischer Bezeihung. *Arch. Hydrobiol.* **35**, 563–624.

_____ (1940) Rotatorien einiger ostdeutscher Torfmoore. *Arch. Hydrobiol.* **36**, 552–587.

_____ (1942) Neue Rotatorienarten aus deutschen Mineralquellen. *Zool. Anz.* **137**, 187–200.

_____ (1951) Das Naturschutzgebiet auf dem Glatzer Schneeberg. Die Rädertiere des Naturschutzgebietes. *Arch. Hydrobiol.* **44**, 441–471.

_____ (1956) Die Rädertiere des Teufelssees bei Friedrichshagen. *Arch. Hydrobiol.* **51**, 457–495.

_____ (1960) Die Rädertiere saurer Gewässer der Dübener Heide. I. Die Rotatorien des Zadlitzmoors und des Wildenhainer Bruchs. *Ibid.* **56**, 311–333.

(1961) Die Rädertiere saurer Gewässer der Dübener Heide. III. Die Rotatorien des Presseler und des Winkelmühler Teiches. *Ibid.* **58**, 72–102.

(1964) Unsere gegenwärtige Kenntnis der Rotatoriengattung *Macrochaetus*. *Limnologica Berlin* **2**, 281–309.

_____ (1965) Rädertiere aus einigen afrikanischen Gewässern. *Ibid* **3**, 347–366.

YAMAMOTO, K. (1953) Preliminary studies on the Rotatorian fauna of Korea. *Pacif. Sci.* **7**, 151–164.